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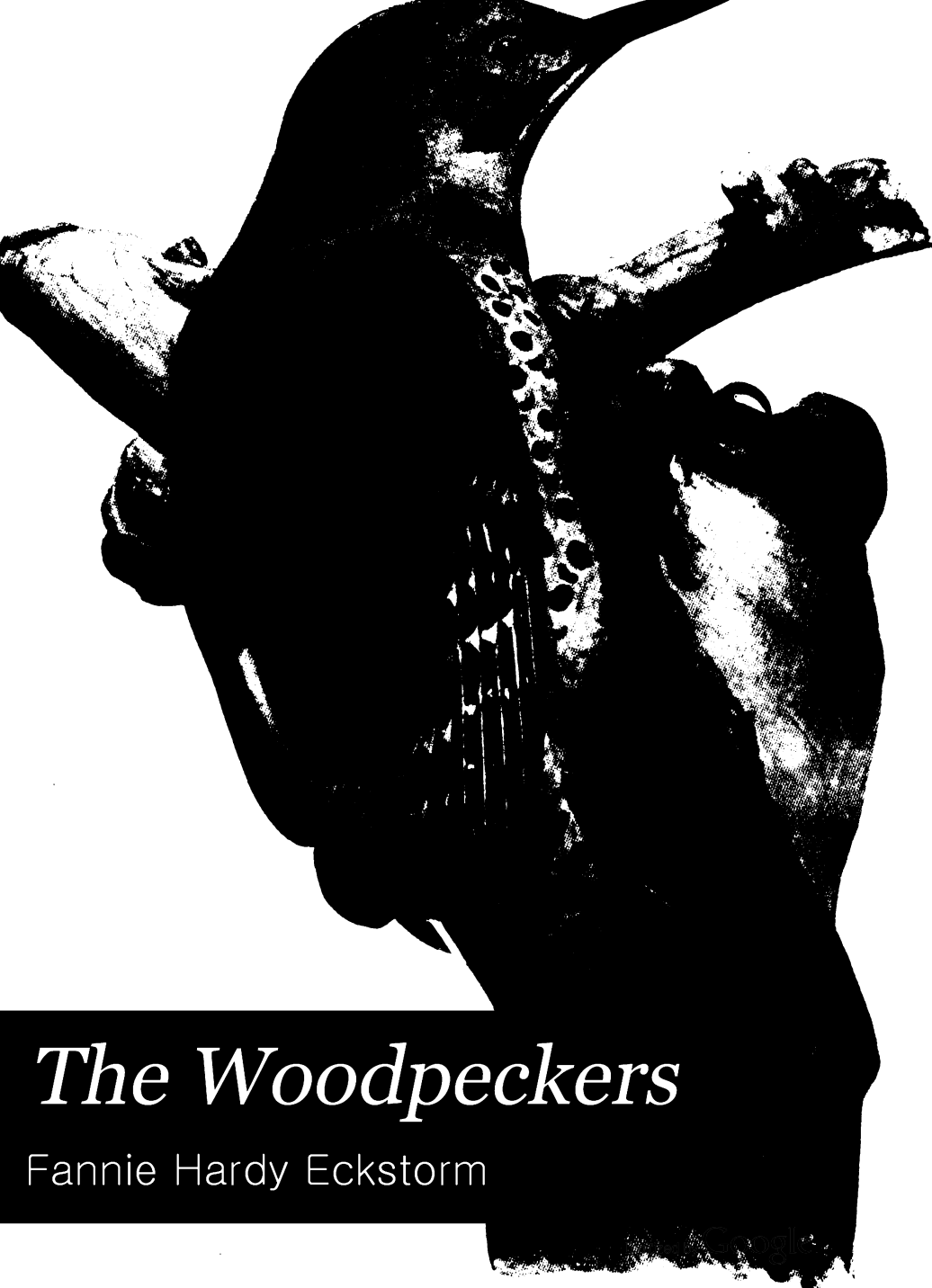

The Woodpeckers

Fannie Hardy Eckstorm

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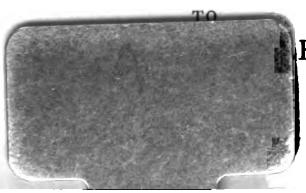

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THE WOODPECKERS

BY

FANNIE HARDY ECKSTORM

WITH ILLUSTRATIONS

BOSTON AND NEW YORK
HOUGHTON, MIFFLIN AND COMPANY
The Riverside Press, Cambridge
1901

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To

MY FATHER

MR. MANLY HARDY

A Lifelong Naturalist

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THE WOODPECKERS

FOREWORD: THE RIDDLERS

LONG ago in Greece, the legend runs, a terrible monster called the Sphinx used to waylay travelers to ask them riddles: whoever could not answer these she killed, but the man who did answer them killed her and made an end of her riddling.

To-day there is no Sphinx to fear, yet the world is full of unguessed riddles. No thoughtful man can go far afield but some bird or flower or stone bars his way with a question demanding an answer; and though many men have been diligently spelling out the answers for many years, and we for the most part must study the answers they have proved, and must reply in their words, yet those shrewd old riddlers, the birds and flowers and bees, are always ready for a new victim, putting their heads together over some new enigma to bar the road to knowledge till that, too, shall be answered;

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so that other men's learning does not always suffice. So much of a man's pleasure in life, so much of his power, depends on his ability to silence these persistent questioners, that this little book was written with the hope of making clearer the kind of questions Dame Nature asks, and the way to get correct answers.

This is purposely a *little* book, dealing only with a single group of birds, treating particularly only some of the commoner species of that group, taking up only a few of the problems that present themselves to the naturalist for solution, and aiming rather to make the reader *acquainted with* the birds than *learned about* them.

The woodpeckers were selected in preference to any other family because they are patient under observation, easily identified, resident in all parts of the country both in summer and in winter, and because more than any other birds they leave behind them records of their work which may be studied after the birds have flown. The book provides ample means for identifying every species and subspecies of woodpecker known in North America, though only five of the commonest and most interesting species have been selected for special study. At least three of these five should be found in

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almost every part of the country. The Californian woodpecker is never seen in the East, nor the red-headed in the far West, but the downy and the hairy are resident nearly everywhere, and some species of the flickers and sapsuckers, if not always the ones chosen for special notice, are visitors in most localities.

Look for the woodpeckers in orchards and along the edges of thickets, among tangles of wild grapes and in patches of low, wild berries, upon which they often feed, among dead trees and in the track of forest fires. Wherever there are boring larvæ, beetles, ants, grasshoppers, the fruit of poison-ivy, dogwood, june-berry, wild cherry or wild grapes, woodpeckers may be confidently looked for if there are any in the neighborhood. Be patient, persistent, wide-awake, sure that you see what you think you see, careful to remember what you have seen, studious to compare your observations, and keen to hear the questions propounded you. If you do this seven years and a day, you will earn the name of Naturalist; and if you travel the road of the naturalist with curious patience, you may some day become as famous a riddle-reader as was that Œdipus, the king of Thebes, who slew the Sphinx.

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I

HOW TO KNOW A WOODPECKER

THE woodpecker is the easiest of all birds to recognize. Even if entirely new to you, you may readily decide whether a bird is a woodpecker or not.

The woodpecker is always striking and is often gay in color. He is usually noisy, and his note is clear and characteristic. His shape and habits are peculiar, so that whenever you see a bird clinging to the side of a tree "as if he had been thrown at it and stuck," you may safely call him a woodpecker. Not that all birds which cling to the bark of trees are woodpeckers, — for the chickadees, the crested titmice, the nuthatches, the brown creepers, and a few others like the kinglets and some wrens and wood-warblers more or less habitually climb up and down the tree-trunks; but these do it with a pretty grace wholly unlike the woodpecker's awkward, cling-fast way of holding on. As the largest of these is smaller than the smallest woodpecker, and as none of them (excepting only the tiny

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kinglets) ever shows the patch of yellow or scarlet which always marks the head of the male woodpecker, and which sometimes adorns his mate, there is no danger of making mistakes.

The nuthatches are the only birds likely to be confused with woodpeckers, and these have the peculiar habit of traveling down a tree-trunk with their heads pointing to the ground. A woodpecker never does this; he may move down the trunk of the tree he is working on, but he will do it by hopping backward. A still surer sign of the woodpecker is the way he sits upon his tail, using it to brace him. No other birds except the chimney swift and the little brown creeper ever do this. A sure mark, also, is his feet, which have two toes turned forward and two turned backward. We find this arrangement in no other North American birds except the cuckoos and our one native parroquet. However, there is one small group of woodpeckers which have but three toes, and these are the only North American land-birds that do not have four well-developed toes.

In coloration the woodpeckers show a strong family likeness. Except in some young birds, the color is always brilliant and often is gaudy. Usually it shows much clear black and white, with dashes of scarlet or yellow about the head.

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Sometimes the colors are "solid," as in the red-headed woodpecker; sometimes they lie in close bars, as in the red-bellied species; sometimes in spots and stripes, as in the downy and hairy; but there is always a *contrast*, never any blending of hues. The red or yellow is laid on in well-defined patches — square, oblong, or crescentic — upon the crown, the nape, the jaws, or the throat; or else in stripes or streaks down the sides of the head and neck, as in the log-cock, or pileated woodpecker.

There is no rule about the color markings of the sexes, as in some families of birds. Usually the female lacks all the bright markings of the male; sometimes, as in the log-cock, she has them but in more restricted areas; sometimes, as in the flickers, she has all but one of the male's color patches; and in a few species, as the red-headed and Lewis's woodpeckers, the two sexes are precisely alike in color. In the black-breasted woodpecker, sometimes called Williamson's sapsucker, the male and female are so totally different that they were long described and named as different birds. It sometimes happens that a young female will show the color marks of the male, but will retain them only the first year.

Though the woodpeckers cling to the trunks

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of trees, they are not exclusively climbing birds. Some kinds, like the flickers, are quite as frequently found on the ground, wading in the grass like meadowlarks. Often we may frighten them from the tangled vines of the frost grape and the branches of wild cherry trees, or from clumps of poison-ivy, whither they come to eat the fruit. The red-headed woodpecker is fond of sitting on fence posts and telegraph poles; and both he and the flicker frequently alight on the roofs of barns and houses and go pecking and pattering over the shingles. The sapsuckers and several other kinds will perch on dead limbs, like a flycatcher, on the watch for insects; the flickers, and more rarely other kinds, will sit crosswise of a limb instead of crouching lengthwise of it, as is the custom with woodpeckers.

All these points you will soon learn. You will become familiar with the form, the flight, and the calls of the different woodpeckers; you will learn not only to know them by name, but to understand their characters; they will become your acquaintances, and later on your friends.

This heavy bird, with straight, chisel bill and sharp-pointed tail-feathers; with his short legs and wide, flapping wings, his unmusical but not disagreeable voice, and his heavy, undulating, business-like flight, is distinctly bourgeois, the

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type of a bird devoted to business and enjoying it. No other bird has so much work to do all the year round, and none performs his task with more energy and sense. The woodpecker makes no aristocratic pretensions, puts on none of the coy graces and affectations of the professional singer; even his gay clothes fit him less jauntily than they would another bird. He is artisan to the backbone, — a plain, hard-working, useful citizen, spending his life in hammering holes in anything that appears to need a hole in it. Yet he is neither morose nor unsocial. There is a vein of humor in him, a large reserve of mirth and jollity. We see little of it except in the spring, and then for a time all the laughter in him bubbles up; he becomes uproarious in his glee, and the melody which he cannot vent in song he works out in the channels of his trade, filling the woodland with loud and harmonious rappings. Above all other birds he is the friend of man, and deserves to have the freedom of the fields.

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II

HOW THE WOODPECKER CATCHES A GRUB

Did you ever see a hairy woodpecker strolling about a tree for what he could pick up?

There is a *whur-r-rp* of gay black and white wings and the flash of a scarlet topknot as, with a sharp cry, he dashes past you, strikes the limb solidly with both feet, and instantly sidles behind it, from which safe retreat he keeps a sharp black eye fixed upon your motions. If you make friends with him by keeping quiet, he will presently forgive you for being there and hop to your side of the limb, pursuing his ordinary work in the usual way, turning his head from side to side, inspecting every crevice, and picking up whatever looks appetizing. Any knot or little seam in the bark is twice scanned; in such places moths and beetles lay their eggs. Little cocoons are always dainty morsels, and large cocoons contain a feast. The butterfly-hunter who is hoping to hatch out some fine cecropia moths knows well that a large proportion of all the cocoons he discovers will be empty.

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The hairy woodpecker has been there before him, and has torn the chrysalis out of its silken cradle. For this the farmer should thank him heartily, even if the butterfly-hunter does not, for the cecropia caterpillar is destructive.

But sometimes, on the fair bark of a smooth limb, the woodpecker stops, listens, taps, and begins to drill. He works with haste and energy, laying open a deep hole. For what? An apple-tree borer was there cutting out the life of the tree. The farmer could see no sign of him; neither could the woodpecker, but he could hear the strong grub down in his little chamber gnawing to make it longer, or, frightened by the heavy footsteps on his roof, scrambling out of the way.

Boring larva.

It is easy to hear the borer at work in the tree. When a pine forest has been burned and the trees are dead but still standing, there will be such a crunching and grinding of borers eating the dead wood that it can be heard on all sides many yards away. Even a single borer can sometimes be heard distinctly by putting the ear to the tree. Sound travels much farther through solids than it does through air; notice how much farther you can hear a railroad train

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by the click of the rails than by the noise that comes on the air. Even our dull ears can detect the woodworm, but we cannot locate him. How, then, is the woodpecker to do what we cannot do?

Doubtless experience teaches him much, but one observer suggests that the woodpecker places the grub by the sense of touch. He says he has seen the red-headed woodpecker drop his wings till they trailed along the branch, as if to determine where the vibrations in the wood were strongest, and thus to decide where the grub was boring. But no one else appears to have noticed that woodpeckers are in the habit of trailing their wings as they drill for grubs. It would be a capital study for one to attempt to discover whether the woodpecker locates his grub by feeling, or whether he does it by hearing alone. Only one should be sure he is looking for grubs and not for beetles' eggs, nor for ants, nor for caterpillars. By the energy with which he drills, and the size of the hole left after he has found his tidbit, one can decide whether he was working for a borer.

But when the borer has been located, he has yet to be captured. There are many kinds of borers. Some channel a groove just beneath the bark and are easily taken; but others tunnel

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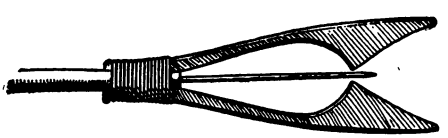
deep into the wood. I measured such a hole the other day, and found it was more than eight inches long and larger than a lead-pencil, bored through solid rock-maple wood. The woodpecker must sink a hole at right angles to this channel and draw the big grub out through his small, rough-sided hole. You would be surprised, if you tried to do the same with a pair of nippers the size of the woodpecker's bill, to find how strong the borer is, how he can buckle and twist, how he braces himself against the walls of his house. Were your strength no greater than the woodpecker's, the task would be much harder. Indeed, a large grub would stand a good chance of getting away but for one thing, — the woodpecker *spears* him, and thereby saves many a dinner for himself.

Here is a primitive Indian fish-spear, such as



Indian spear.

the Penobscots used. To the end of a long pole two wooden jaws are tied loosely enough to spring apart a little under pressure, and midway between them, firmly driven into the end of the

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pole, is a point of iron. When a fish was struck, the jaws sprung apart under the force of the blow, guiding the iron through the body of the fish, which was held securely in the hollow above, that just fitted around his sides, and by the point itself.

Solomon Islander's spear.

The tool with which the woodpecker fishes for a grub is very much the same. His mandibles correspond to the two movable jaws. They are knife-edged, and the lower fits exactly inside the upper, so that they give a very firm grip. In addition, the upper one is movable. All birds can move the upper mandible, because it is hinged to the skull. (Watch a parrot some day, if you do not believe it.) A medium-sized woodpecker, like the Lewis's, can elevate his upper mandible at least a quarter of an inch without opening his mouth at all. This enables him to draw his prey through a smaller hole than would be needed if he must open his jaws along their whole length. Between the mandibles is the sharp-pointed tongue, which can be thrust entirely through a grub, holding him impaled. Unlike the Indian's spear-point, the woodpecker's tongue is

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barbed heavily on both sides, and it is extensile. As a tool it resembles the Solomon Islander's spear. A medium-sized woodpecker can dart his tongue out two inches or more beyond the tip of his bill. A New Bedford boy might tell us, and very correctly, that the woodpecker *harpoons* his grub, just as a whaleman harpoons a whale. If the grub tries to back off into his burrow, out darts the long, barbed tongue and spears him. Then it drags him along the crooked tunnel and into the narrow shaft picked by the woodpecker, where the strong jaws seize and hold him firmly.

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III

HOW THE WOODPECKER COURTS HIS MATE

OTHER birds woo their mates with songs, but the woodpecker has no voice for singing. He cannot pour out his soul in melody and tell his love his devotion in music. How do songless birds express their emotions? Some by grotesque actions and oglings, as the horned owl, and some by frantic dances, as the sharp-tailed grouse, woo and win their mates; but the amorous woodpecker, not excepting the flickers, which also woo by gestures, whacks a piece of seasoned timber, and rattles off interminable messages according to the signal code set down for woodpeckers' love affairs. He is the only instrumental performer among the birds; for the ruffed grouse, though he drums, has no drum.

There is no cheerier spring sound, in our belated Northern season, than the quick, melodious rappings of the sapsucker from some dead ash limb high above the meadow. It is the best performance of its kind: he knows the capabilities of his instrument, and gets out of it all the

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music there is in it. Most if not all woodpeckers drum occasionally, but drumming is the special accomplishment of the sapsucker. He is easily first. In Maine, where they are abundant, they make the woods in springtime resound with their continual rapping. Early in April, before the trees are green with leaf, or the pussy-willows have lost their silky plumpness, when the early round-leafed yellow violet is cuddling among the brown, dead leaves, I hear the yellow-bellied sapsucker along the borders of the trout stream that winds down between the mountains. The dead branch of an elm-tree is his favorite perch, and there, elevated high above all the lower growth, he sits rolling forth a flood of sound like the tremolo of a great organ. Now he plays staccato, — detached, clear notes; and now, accelerating his time, he dashes through a few bars of impetuous hammerings. The woods reëcho with it; the mountains give it faintly back. Beneath him the ruffed grouse paces back and forth on his favorite mossy log before he raises the palpitating whirr of his drumming. A chickadee digging in a rotten limb pauses to spit out a mouthful of punky wood; and the brown *Vanessa*, edged with yellow, first butterfly of the season, flutters by on rustling wings. So

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spring arrives in Maine, ushered in by the reveille of the sapsucker.

So ambitious is the sapsucker of the excellence of his performance that no instrument but the best will satisfy him. He is always experimenting, and will change his anvil for another as soon as he discovers one of superior resonance. They say he tries the tin pails of the maple-sugar makers to see if these will not give him a clearer note; that he drums on tin roofs and waterspouts till he loosens the solder and they come tumbling down. But usually he finds nothing so near his liking as a hard-wood branch, dead and barkless, the drier, the harder, the thinner, the finer grained, so much the better for his uses.

Deficient as they are in voice, the woodpeckers do not lack a musical ear. Mr. Burroughs tells us that a downy woodpecker of his acquaintance used to change his key by tapping on a knot an inch or two from his usual drumming place, thereby obtaining a higher note. Alternating between the two places, he gave to his music the charm of greater variety. The woodpeckers very quickly discover the superior conductivity of metals. In parts of the country where woodpeckers are more abundant than good drumming trees, a tin roof proves an

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almost irresistible attraction. A lightning-rod will sometimes draw them farther than it would an electric bolt; and a telegraph pole, with its tinkling glasses and ringing wires, gives them great satisfaction. If men did not put their singing poles in such public places, their music would be much more popular with the woodpeckers; but even now the birds often venture on the dangerous pastime and hammer you out a concord of sweet sounds from the mellow wood-notes, the clear peal of the glass, and the ringing overtones of the wires.

The flicker often telegraphs his love by tapping either on a forest tree or on some loose board of a barn or outhouse; but he has other ways of courting his lady. On fine spring mornings, late in April, I have seen them on a horizontal bough, the lady sitting quietly while her lover tried to win her approval by strange antics. Quite often there are two males displaying their charms in open rivalry, but once I saw them when the field was clear. If fine clothes made a gentleman, this brave wooer would have been first in all the land: for his golden wings and tail showed their glittering under side as he spread them; his scarlet headdress glowed like fire; his rump was radiantly white, not to speak of the jetty black of his other ornaments and

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the beautiful ground-colors of his body. He danced before his lady, showing her all these beauties, and perhaps boasting a little of his own good looks, though she was no less beautiful. He spread his wings and tail for her inspection; he bowed, to show his red crescent; he bridled, he stepped forward and back and sidewise with deep bows to his mistress, coaxing her with the mellowest and most enticing *co-wee-tucks*, which no doubt in his language meant "Oh, promise me," laughing now and then his jovial *wick-a-wick-a-wick-a-wick-a*, either in glee or nervousness. It was all so very silly — and so very nice! I wonder how it all came out. Did she promise him? Or did she find a gayer suitor?

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IV

HOW THE WOODPECKER MAKES A HOUSE

ALL woodpeckers make their houses in the wood of trees, either the trunk or one of the branches. Almost the only exceptions to this rule are those that live in the treeless countries of the West. In the torrid deserts of Arizona and the Southwest, some species are obliged to build in the thorny branches of giant cacti, which there grow to an enormous size. In the treeless plains to the northward, a few individuals, for lack of anything so suitable as the cactus, dig holes in clay banks, or even lay their eggs upon the surface of the prairie. In a country where chimney swallows nest in deserted houses, and sand martins burrow in the sides of wells, who wonders at the flicker's thinking that the side of a haystack, the hollow of a wheel-hub, or the cavity under an old ploughshare, is an ideal home? But in wooded countries the woodpeckers habitually nest in trees. The only exceptions I know are a few flickers' holes in old posts, and a few instances where flickers

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have pecked through the weatherboarding of a house to nest in the space between the walls.

But because a bird nests in a hole in a tree, it is not necessarily a woodpecker. The sparrow-hawk, the house sparrow, the tree swallow, the bluebird, most species of wrens, and several of the smaller species of owls nest either in natural cavities in trees or in deserted woodpeckers' holes. The chickadees, the crested titmice, and the nuthatches dig their own holes after the same pattern as the woodpecker's. However, the large, round holes were all made by woodpeckers, and of those under two inches in diameter, our friend Downy made his full share. It is easy to tell who made the hole, for the different birds have different styles of housekeeping. The chickadees and nuthatches always build a soft little nest of grass, leaves, and feathers, while the woodpeckers lay their eggs on a bed of chips, and carry nothing in from outside.

Soon after they have mated in the spring, the woodpeckers begin to talk of housekeeping. First, a tree must be chosen. It may be sound or partly decayed, one of a clump or solitary; but it is usually dead or hollow-hearted, and at least partly surrounded by other trees. Sometimes a limb is chosen, sometimes an upright trunk, and the nest may be from two feet to one hundred

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feet from the ground, though most frequently it will be found not less than ten nor more than thirty feet up. However odd the location finally occupied, it is likely that it was not the first one selected. A woodpecker will dig half a dozen houses rather than occupy an undesirable tenement. It is very common to find their unfinished holes and the wider-mouthed, shallower pockets which they dig for winter quarters; for those that spend their winters in the cold North make a hole to live in nights and cold and stormy days.

The first step in building is to strike out a circle in the bark as large as the doorway is to be; that is, from an inch and a half to three or four inches in diameter according to the size of the woodpecker. It is nearly always a perfect circle. Try, if you please, to draw freehand a circle of dots as accurate as that which the woodpecker strikes out hurriedly with his bill, and see whether it is easy to do as well as he does.

If the size and shape of the doorway suit him, the woodpecker scales off the bark inside his circle of holes and begins his hard work. He seems to take off his coat and work in his shirt-sleeves, so vigorously does he labor as he clings with his stout toes, braced in position by his pointed tail. The chips fly out past him, or if

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they lie in the hole, he sweeps them out with his bill and pelts again at the same place. The pair take turns at the work. Who knows how long they work before resting? Do they take turns of equal length? Does one work more than the other? A pair of flickers will dig about two inches in a day, the hole being nearly two and a half inches in diameter. A week or more is consumed in digging the nest, which, among the flickers, is commonly from ten to eighteen inches deep. The hole usually runs in horizontally for a few inches and then curves down, ending in a chamber large enough to make a comfortable nest for the mother and her babies.

What a good time the little ones have in their hole! Rain and frost cannot chill them; no enemy but the red squirrel is likely to disturb them. There they lie in their warm, dark chamber, looking up at the ray of light that comes in the doorway, until at last they hear the scratching of their mother's feet as she alights on the outside of the tree and clambers up to feed them. What a piping and calling they raise inside the hole, and how they all scramble up the walls of their chamber and thrust out their beaks to be fed, till the old tree looks as if it were blossoming with little woodpeckers' hungry mouths!

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V

HOW A FLICKER FEEDS HER YOUNG[1]

As the house of the woodpecker has no windows and the old bird very nearly fills the doorway when she comes home, it is hard to find out just how she feeds her little ones. But one of our best naturalists has had the opportunity to observe it, and has told what he saw.

A flicker had built a nest in the trunk of a rather small dead tree which, after the eggs were hatched, was accidentally broken off just at the entrance hole. This left the whole cavity exposed to the weather; but it was too late to desert the nest, and impossible to remove the young birds to another nest.

When first visited, the five little birds were blind, naked, and helpless. They were motherless, too. Some one must have killed their pretty mother; for she never came to feed them, and the father was taking all the care of his little family. When disturbed the little birds hissed like snakes, as is the habit of the callow young

[1] Based upon the observations of Mr. William Brewster.

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of woodpeckers, chickadees, and other birds nesting habitually in holes in trees. When they were older and their eyes were open, they made a clatter much like the noise of a mowing-machine, and loud enough to be heard thirty yards away.

The father came at intervals of from twenty to sixty minutes to feed the little ones. He was very shy, and came so quietly that he would be first seen when he alighted close by with a low little laugh or a subdued but anxious call to the young. "Here I am again!" he laughed; or "Are you all right, children?" he called to them. "All right!" they would answer, clattering in concert like a two-horse mower.

As soon as they heard him scratching on the tree-trunk, up they would all clamber to the edge of the nest and hold out their gaping mouths to be fed. Each one was anxious to be fed first, because there never was enough to go round. There was always one that, like the little pig of the nursery tale, "got none." When he came to the nest, the father would look around a moment, trying to choose the one he wanted to feed first. Did he always pick out the poor little one that had none the time before, I wonder?

After the old bird had made his choice, he would bend over the little bird and drive his long bill down the youngster's throat as if to

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run it through him. Then the little bird would catch hold as tightly as he could and hang on while his father jerked him up and down for a second or a second and a half with great rapidity. What was he doing? He was pumping food from his own stomach into the little one's. Many birds feed their young in this way. They do not hold the food in their own mouths, but swallow and perhaps partially digest it, so that it shall be fit for the tender little stomachs.

While the woodpecker was pumping in this manner his motions were much the same as when he drummed, but his tail twitched as rapidly as his head and his wings quivered. The motion seemed to shake his whole body.

In two weeks from the time when the little birds were blind, naked, helpless nestlings they became fully feathered and full grown, able to climb up to the top of the nest, from which they looked out with curiosity and interest. At any noise they would slip silently back. A day or two later they left the old nest and began their journeys.

No naturalist has been able to tell us whether other woodpeckers than the golden-winged flicker feed their young in this way, and little is known of the number of kinds of birds that use this method, but it is suspected that it is far more

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common than has ever been determined. If an old bird is seen to put her bill down a young one's throat and keep it there even so short a time as a second, it is probable that she is feeding the little one by regurgitation, that is, by pumping up food from her own stomach. Any bird seen doing this should be carefully watched. It has long been known that the domestic pigeon does this, and the same has been observed a number of times of the ruby-throated hummingbird. A California lady has taken some remarkable photographs of the Anna's hummingbird in the act, showing just how it is done.

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VI

FRIEND DOWNY

No better little bird comes to our orchards than our friend the downy woodpecker. He is the smallest and one of the most sociable of our woodpeckers, — a little, spotted, black-and-white fellow, precisely like his larger cousin the hairy, except in having the outer tail-feathers barred instead of plain. Nearly everything that can be said of one is equally true of the other on a smaller scale. They look alike, they act alike, and their nests and eggs are alike in everything but size.

Downy is the most industrious of birds. He is seldom idle and never in mischief. As he does not fear men, but likes to live in orchards and in the neighborhood of fields, he is a good friend to us. On the farm he installs himself as Inspector of Apple-trees. It is an old and an honorable profession among birds. The pay is small, consisting only of what can be picked up, but, as cultivated trees are so infested with insects that food is always plentiful, and as they have

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Downy Woodpecker

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usually a dead branch suitable to nest in, Downy asks no more. Summer and winter he works on our orchards. At sunrise he begins, and he patrols the branches till sunset. He taps on the trunks to see whether he can hear any rascally borers inside. He inspects every tree carefully in a thorough and systematic way, beginning low down and following up with a peek into every crevice and a tap upon every spot that looks suspicious. If he sees anything which ought not to be there, he removes it at once.

A moth had laid her eggs in a crack in the bark, expecting to hatch out a fine brood of caterpillars: but Downy ate them all, thus saving a whole branch from being overrun with caterpillars and left fruitless, leafless, and dying. A beetle had just deposited her eggs here. Downy saw her, and took not only the eggs but the beetle herself. Those eggs would have hatched into boring larvæ, which would have girdled and killed some of the branches, or have burrowed under the bark, causing it to fall off, or have bored into the wood and, perhaps, have killed the tree. Nor is the full-grown borer exempt. Downy hears him, pecks a few strokes, and harpoons him with unerring aim. When Downy has made an arrest in this way, the prisoner does not escape from the police. Here is a colony

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of ants, running up the tree in one line and down in another, touching each other with their feelers as they pass. A feast for our friend! He takes both columns, and leaves none to tell the tale. This is a good deed, too, since ants are of no benefit to fruit-trees and are very fond of the dead-ripe fruit.

And Downy is never too busy to listen for borers. They are fine plump morsels much to his taste, not so sour as ants, nor so hard-shelled as beetles, nor so insipid as insects' eggs. A good borer is his preferred dainty. The work he does in catching borers is of incalculable benefit, for no other bird can take his place. The warblers, the vireos, and some other birds in summer, the chickadees and nuthatches all the year round, are helping to eat up the eggs and insects that lie near the surface, but the only birds equipped for digging deep under the bark and dragging forth the refractory grubs are the woodpeckers.

So Downy works at his self-appointed task in our orchards summer and winter, as regular as a policeman on his beat. But he is much more than a policeman, for he acts as judge, jury, jailer, and jail. All the evidence he asks against any insect is to find him loafing about the premises. "I swallow him first and find out after-

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wards whether he was guilty," says Downy with a wink and a nod.

Most birds do not stay all the year, in the North, at least, and most, in return for their labors in the spring, demand some portion of the fruit or grain of midsummer and autumn. Not so Downy. His services are entirely gratuitous; he works twice as long as most others. He spends the year with us, no winter ever too severe for him, no summer too hot; and he never taxes the orchard, nor takes tribute from the berry patch. Only a quarter of his food is vegetable, the rest being made up of injurious insects; and the vegetable portion consists entirely of wild fruits and weed-seeds, nothing that man eats or uses. Downy feeds on the wild dogwood berries, a few pokeberries, the fruit of the woodbine, and the seeds of the poison-ivy, — whatever scanty and rather inferior fare is to be had at Nature's fall and winter table. If in the cold winter weather we will take pains to hang out a bone with some meat on it, raw or cooked, or a piece of suet, taking care that it is not salted, — for few wild birds except the crossbills can eat salted food, — we may see how he appreciates our thoughtfulness. Shall we grudge him a bone from our own abundance, or neglect to fasten it firmly out of reach of the cat

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and dog? If his cousin the hairy and his neighbor the chickadee come and eat with him, bid them a hearty welcome. The feast is spread for all the birds that help men, and friend Downy shall be their host.

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VII

PERSONA NON GRATA

We shall not attempt to deny that Downy has an unprincipled relative. While it is no discredit, it is a great misfortune to Downy, who is often murdered merely because he looks a little, a very little, like this disreputable cousin of his. The real offender is the sapsucker, that musical genius of whom we have already spoken.

The popular belief is that every woodpecker is a sapsucker, and that every hole he digs in a tree is an injury to the tree. We have seen that every hole Downy digs is a benefit, and now we wish to learn why it is that the sapsucker's work is any more injurious than other woodpeckers' holes; how we are to recognize the sapsucker's work; and how much damage he does. We will do what the scientists often do, — examine the bird's work and make it tell us the story. There is no danger of hurting the sapsucker's reputation. The farmer could have no worse opinion of him; and, though the case has been appealed to the higher courts of science more than once,

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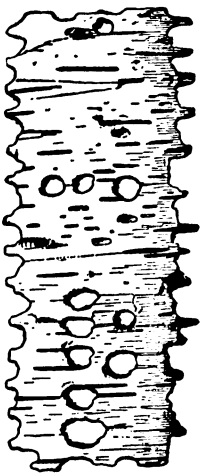
where the sapsucker's cause has been eloquently and ably defended, the verdict has gone against him. Scientists now do not deny that the sapsucker does harm. But his worst injury is less in the damage he does to the trees than in the ill-will and suspicion he creates against woodpeckers which do no harm at all. If you will study the picture and the descriptions in the Key to the Woodpeckers, you will be able to recognize the sapsucker and his nearest relatives, whether in the East or in the West. But all sapsuckers may be known by their pale yellowish under parts, and by the work they leave behind. As the yellow-bellied sapsucker is the only one found east of the Rocky Mountains, we shall speak only of him and his work.



Work of Sapsucker.

Here is a specimen of the yellow-bellied sapsucker's work which I picked up under the tree from which it had fallen. We do not need to inquire whether the tree was injured by its falling, for we know that the loss of sound and healthy bark is always a damage. Was this sound bark? Yes, because it is still firm and new. The sap in it dried

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Yellow-bellied Sapsucker

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quickly, showing that neither disease nor worms caused it to fall; it is clean and hard on the back, showing that it came from a live tree, not from a dead, rotting log.

How do I know that a bird caused it to fall? The marks are precisely such as are always left by a woodpecker's bill. How do I know that it was a sapsucker's work? Because no other woodpecker has the habit which characterizes the sapsucker, of sinking holes in straight lines. The sapsuckers drill lines of holes sometimes around and sometimes up and down the tree-trunk, but almost always in rings or belts about the trunk or branches. A girdle may be but a single line of holes, or it may consist of four or five, or more, lines. Sometimes a band will be two feet wide; and as many as eight hundred holes have been counted on the trunk of a single tree. Such extensive peckings, however, are to be expected only on large forest trees. Most fruit and ornamental trees are girdled a few times about the trunk, and about the principal branches just below the nodes, or forks.

Why did the bird dig these holes? There are three things that he might have obtained, — sap, the inner bark, and boring larvæ. Some naturalists have suggested a fourth as possible, — the insects that would be attracted by the sap.

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We will see what the piece of bark tells us. It is four and a half inches long, by an inch and a half wide, and its area of six and three fourths square inches has forty-four punctures. Does this look as if the bird were digging grubs? Do borers live in such straight little streets? The number and arrangement of the holes show that he was not seeking borers, while the naturalists tell us that he never eats a borer unless by accident. What did he get? Undoubtedly he pecked away some of the inner bark. All these holes are much larger on the back side of the specimen than on the outer surface. While the damp inner bark would shrink a little on exposure to the air, we know that it could not shrink as much as this; and investigation has shown that the sapsucker feeds largely on just such food, for it has been found in his stomach. Two other possible food-substances remain, — sap and insects. We know that the sapsucker eats many insects, but it is impossible to prove that he intended these holes for insect lures. Sap he might have gotten from them, if he wished it. We know that the white birch is full of excellent sap, from which can be made a birch candy, somewhat bitter, but nearly as good as horehound candy. The rock and red maples and the white canoe birch are the only trees in

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our Northern forests from which we make candy. A strong probability that our bird wanted sap is indicated by the arrangement of the holes. Usually he drills his holes in rings around the tree-trunk, but in this instance his longest lines of holes are vertical. If our sapsucker was drilling for sap, he arranged his holes so that it would almost run into his mouth, lazy bird!

Our piece of bark has taught us: —

That the sapsucker injured this tree.

That he was not after grubs.

That he got, and undoubtedly ate, the soft inner bark of the tree.

That he got, and may have drunk, the sap.

We could not infer any more from a single instance, but the naturalists assure us that the bird is in the habit of injuring trees, that he never eats grubs intentionally, and that he eats too much bark for it to be regarded as taken accidentally with other food. About the sap they cannot be so sure, as it digests very quickly. There remain two points to prove: whether the sapsucker drills his holes for the sake of the sap, or for insects attracted by the sap, provided that he eats anything but the inner bark.

Our little specimen can tell us no more, but two mountain ash trees which were intimate acquaintances of mine from childhood can go on

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with the story. Do not be surprised that I speak of them as friends; the naturalist who does not make *friends* of the creatures and plants about will hear few stories from them. These trees would not tell this tale to any one but an intimate acquaintance. Let us hear what they have to say about the sapsucker.

There are in the garden of my old home two mountain ash trees, thirty-six years of age, each having grown from a sprout that sprang up beside an older tree cut down in 1863. They stand not more than two rods apart; have the same soil, the same amount of sun and rain, the same exposure to wind, and equal care. During all the years of my childhood one was a perfectly healthy tree, full of fruit in its season, while the other bore only scanty crops, and was always troubled with cracked and scaling bark. To-day the unhealthy tree is more vigorous than ever before, while its formerly stalwart brother stands a mere wreck of its former life and beauty. What should be the cause of such a remarkable change when all conditions of growth have remained the same?

I admit that there is some internal difference in the trees, for all the birds tell me of it. One has always borne larger and more abundant fruit than the other, but this is no reason why the

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birds should strip all the berries from that tree before eating any from the other. When we know that the favorite tree stands directly in front of the windows of a much-used room and overhangs a frequented garden path, the preference becomes more marked. But robins, grosbeaks, purple finches, and the whole berry-eating tribe agree to choose one and neglect the other, and even the spring migrants will leave the gay red tassels of fruit still swinging on one tree, to scratch over the leaves and eat the fallen berries that lie beneath the other. My own taste is not keen in choosing between bitter berries, but the birds all agree that there is a decided difference in these trees, — did agree, I should say, for their favorite is the tree that is dying. Evidently this is a question of taste. It is interesting to observe that the sapsucker, which was never seen to touch the fruit of the trees, agrees with the fruit-eating birds. Nearly all his punctures were in the tree now dying. Is there a difference in the taste of the sap? Does the taste of the sap affect the taste of the fruit? Or is it merely a question of quantity? If he comes for sap, he prefers one tree to the other on the score either of better quality or greater quantity.

We will discuss later whether it is sap that he wishes: all that now concerns us is to note

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that the internal difference, whatever it is, is in favor of the tree that is dying; while the only external difference appears to be the marks left by the sapsucker. While one tree is sparingly marked by him, the other is tattooed with his punctures, placed in single rings and in belts around trunk and branches beneath every fork. It is a law of reasoning that, when every condition but one is the same and the effects are different, the one exceptional condition is the *cause* of the difference. If these trees are alike in everything except the work of the sapsucker (the only internal difference apparently *offsetting* his work in part), what inference do we draw as to the effect of his work?

We presume that he is killing the tree, without as yet knowing how he does it. What is his object? Good observers have stated that he draws a little sap in order to attract flies and wasps; that the sap is not drawn for its own sake, but as a bait for insects. Is this theory true?

The first objection is that it is improbable. The sapsucker is a retiring, woodland bird that would hesitate to come into a town garden a mile away from the nearest woods unless to get something he could not find in the woods. Had he wanted insects, he would have tapped a tree

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in the woods, or else he would have caught them in his usual flycatching fashion. There must have been something about the mountain ash tree that he craved. As it is a very rare tree in the vicinity of my home, the sapsucker's only chance to satisfy his longing was by coming to some town garden like our own.

Not only is the theory improbable, but it fails to explain the sapsucker's actions in this instance. In twenty years he was never seen to catch an insect that was attracted by the sap he drew. This does not deny that he may have caught insects now and then, but it does deny that he set the sap running for a lure. As he was never far away, and was sometimes only four and a half feet by measure from a chamber window, all that he did could be seen. He did not catch insects at his holes. He drank sap and ate bark.

Finally, the theory is not only improbable and inadequate, but in this instance it is impossible. I do not remember seeing a sapsucker in the tree in the spring; if he came in the summer, it must have been at rare intervals; but he was always there in the fall, when the leaves were dropping. At that season the insect hordes had been dispersed by the autumnal frosts, so that we know he did not come for insects.

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In the many years during which I watched the sapsuckers — for there were undoubtedly a number of different birds that came, although never more than one at a time — there was such a curious similarity in their actions that it is entirely proper to speak as if the same bird returned year after year. His visits, as I have said, were usually made at the same season. He would come silently and early, with the evident intention of making this an all-day excursion. By eight o'clock he would be seen clinging to a branch and curiously observant of the dining-room window, which at that hour probably excited both his interest and his alarm. Early in the day he showed considerable activity, flitting from limb to limb and sinking a few holes, three or four in a row, usually *above* the previous upper girdle of the limbs he selected to work upon. After he had tapped several limbs he would sit waiting patiently for the sap to flow, lapping it up quickly when the drop was large enough. At first he would be nervous, taking alarm at noises and wheeling away on his broad wings till his fright was over, when he would steal quietly back to his sap-holes. When not alarmed, his only movement was from one row of holes to another, and he tended them with considerable regularity. As the day wore on

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he became less excitable, and clung cloddishly to his tree-trunk with ever increasing torpidity, until finally he hung motionless as if intoxicated, tippling in sap, a disheveled, smutty, silent bird, stupefied with drink, with none of that brilliancy of plumage and light-hearted gayety which made him the noisiest and most conspicuous bird of our April woods.

Our mountain ash trees have told us several facts about the sapsucker: —

That he did not come to eat insects.

That he did come to drink sap, and that he probably ate the inner bark also.

That he drank the sap because he liked it, not for some secondary object, as insects.

That he could detect difference in the quality or quantity of the sap, which caused him to prefer a particular tree.

That this difference apparently was in the taste of the sap, and that the effects of a day's drinking of mountain ash sap seemed to indicate some intoxicant or narcotic quality in the sap of that particular tree.

That the effect of his work upon the tree was apparently injurious, as it is the only cause assigned of a healthy tree's dying before a less healthy one of the same age and species, subject all its life to the same conditions.

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So much we have learned about the sapsucker's habits, and now we should like to know why his work is harmful, and why that of the other woodpeckers is not. It is not because he drinks the sap. All the sap he could eat or waste would not harm the tree, if allowed to run out of a few holes. Think how many gallons the sugar-makers drain out of a single tree without killing the tree. But the sugar-maker takes the sap in the spring, when the crude sap is mounting up in the tree, while the sapsucker does not begin his work till midsummer or autumn, when the tree is sending down its elaborated sap to feed the trunk and make it grow. This accounts for the woodpecker's digging his pits *above* the lines of holes already in the tree. The loss of this elaborated sap is a greater injury than the waste of a far larger quantity of crude sap, so that on the season of the year when the sapsucker digs his holes depends in large measure the amount of damage he does. The injury that he does to the wood itself is trivial. He is not a wood*pecker* except at time of nesting, and most woodpeckers prefer to build in a dead or dying branch, where their work does no hurt. But we know very well that a tree may be a wreck, riven from top to bottom by lightning, split open to the heart by the tem-

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pest, entirely hollow the whole length of its trunk, and yet may flourish and bear fruit. The tree lives in its outer layers. It may be crippled in almost any way, if the bark is left uninjured; but if an inch of bark is cut out entirely around the tree, it will die, for the sap can no longer run up and down to nourish it.

This is the sapsucker's crime: he girdles the tree, — not at his first coming, nor yet at his second, not with one row of holes, nor yet with two; but finally, after years perhaps, when row after row of punctures, each checking a little the flow of sap, have overlapped and offset each other and narrowed the channels through which it could mount and descend, until the flow is stopped. Then the tree dies. It is not the holes he makes, nor the sap he draws, but the way he places his holes that makes the sapsucker an unwelcome visitor. For an unacceptable individual he is to the farmer, — *persona non grata*, as kings say of ambassadors who do not please their majesties. What shall we do with him, the only black sheep in all the woodpecker flock? Let him alone, unless we are positively sure that we know him from every other kind of woodpecker. The damage he does is trifling compared with what we should do if we made war upon other woodpeckers for some supposed wrong-doing of the sapsucker.

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VIII

EL CARPINTERO

In California and along the southwestern boundary of the United States lives a woodpecker known among the Mexicans as El Carpintero, the Carpenter.

Carpentering is both his profession and his pastime, and he seems really to enjoy the work. When there is nothing more pressing to be done, he spends his time tinkering around, fitting acorns into holes in such great numbers and in so workmanlike a fashion that we do not know which is more remarkable, his patience or his skill. Every acorn is fitted into a separate hole made purposely for it, every one is placed butt end out and is driven in flush with the surface, so that a much frequented tree often appears as if studded with ornamental nails. "What an industrious bird!" we exclaim; but still it takes some time to appreciate how enormous is the labor of the Carpenter. Whole trees will sometimes be covered with his work, until a single tree has thousands of acorns bedded into its bark

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so neatly and tightly that no other creature can remove them.

We may take for examination, from specimens

Work of Californian Woodpecker.

of the Carpenter's work, a piece of spruce bark seven inches long by six wide, containing ten acorns and two empty holes. As spruce bark is so much harder and rougher than the pine

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bark in which he usually stores his nuts,[1] this specimen looks rough and unfinished, and even shows some acorns driven in sidewise; but for another reason I have preferred it to better-looking examples of his work for study. As we shall see later, it gives us a definite bit of information about the bird.

Think of the work of digging these twelve holes. Think of the labor of carrying these ten large acorns and driving them in so tightly that after years of shrinking they cannot be removed by a knife without injuring either the acorn or the bark. Yet how small a part of the woodpecker's year's work is here! How long could he live on ten acorns? How many must he gather for his winter's needs? How many must he lose by forgetting to come back to them? We cannot calculate the work a single bird does nor the nuts he eats, for several birds usually work in company and may use the same tree; but all the woodpeckers are large eaters, and the Californian has been singled out for special mention.

Can we estimate the amount of work required to lay up one day's food? Judging by the

[1] They often use white-oak bark, fence-posts, telegraph poles, even the stalks of century-plants, when trees are not convenient. (Merriam, *Auk*, viii. 117.)

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Californian Woodpecker

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amount of nuts some other birds will eat, I should think that all ten acorns contained in this piece of bark could be eaten in one day without surfeit. The estimate seems to me well inside of his probable appetite. I have experimented on this piece of bark, using a woodpecker's bill for a tool, and it takes me twenty minutes to dig a hole as large but not as neat as these. Doubtless it would not take the woodpecker as long; but at my rate of working, four hours were spent in digging these twelve holes. Then each acorn had to be hunted up and brought to the hole prepared for it. This entailed a journey, it may have been only from one tree to another, or it may have been, and very likely was, a considerable flight. For these acorns grew on oak-trees, and we find them driven into the bark of pines and spruces.

This it is which gives our specimen its particular interest. While oaks and pines may be intermingled, though they naturally prefer different soils and situations, and in the Rocky Mountains the pine-belt lies above the oak region, spruce and oak trees do not grow in the same soil. The spruce-belt stands higher up than the pine. As these nuts are stored in the bark of a spruce-tree, we have clear evidence that the bird must have carried them some distance. For every

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nut he made the whole journey back and forth, since he could carry but one at a time, — ten long trips back and forth, certainly consuming several minutes each.

Then each acorn had to be fitted to its hole. We have already spoken of the accuracy with which this is done, so that the Carpenter's work is a standing taunt to the hungry jays and squirrels which would gladly eat his nuts if they could get them. A careful observer tells us that when the hole is too small, the woodpecker takes the acorn out and makes the hole a little larger, working so cautiously, however, that he sometimes makes several trials before the acorn can be fitted and driven in flush with the bark. Some of these acorns show cracks down the sides, as if they had been split either in forcibly pulling them out of a hole not deep enough for them, or in driving them when green and soft into a hole too small for them. Of course after each trial the acorn must be hunted up where it lies on the ground and driven in again, and this takes considerable time.

As nearly as we can estimate it, not less than half a day must have been spent in putting these acorns where we find them. With smaller acorns, stored in pine bark, less time would have

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been required; but weeks, if not months, of work are spent in laying up the winter's stores.

How the woodpecker's back and jaws must have ached! Surely he is human enough to get tired with his work, and it is not play to do what this bird has done. Some of the acorns measure seven tenths of an inch in diameter by nine tenths in length, and the bird that carried them is smaller than a robin. How he must have hurried to reach his tree when the acorn was extra large! Yet he took time to drive every one in point foremost. Even those that lie upon their sides must have been forced into position by tapping the butt. He knows very well which end of an acorn is which, does our Carpenter.

But what is the use of all this work? Why, if he wants acorns, does he not eat them as they lie scattered under the oaks, instead of taking pains to carry them away and put them into holes for the fun of eating them out of the holes afterward? The absurdity of this has led some people to surmise that the Carpenter chooses none but weevilly acorns, and stores them that the grub inside may grow large and fat and delicious. This would be very interesting, if it were true. There must of course be more weevilly acorns on the ground than he

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picks up, so that he could get as many grubs without taking all this trouble, and there is no reason why they should not be as large and good as those hatched out in holes in trees. When I wish to keep nuts sweet, I spread them out on the attic floor in the sun and air, keeping them where they will not touch each other. The Carpenter does practically the same thing. Is it probable that he tries to raise a fine crop of grubs in this way? If so, one or the other of us is doing just the wrong thing. But if weevils are what the Carpenter wants, then the nuts in the bark should be wormy; yet only two of them show any sign of a weevil, and of these one appears from its dull color and weather-beaten look to be a nut deposited several years before the others by some other woodpecker. Every other acorn is as hard, shining, and bright colored as when it fell from the tree. Evidently the bird picked these nuts up while they were fresh and good; perhaps he chose them *because* they were good and fresh. The possibility becomes almost a certainty when we observe that naturalists agree that the Carpenter uses no acorns but the sweet-tasting species. Now there are likely to be as many grubs in one kind of an acorn as in another, and he would scarcely refuse any kind that contained them, if grubs

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were what he wanted. The fact that he takes sweet acorns, and those only, shows that it is the meat of the nut that he wants. And all good naturalists agree that it is the kernel itself that he eats.

Why he stores them is not hard to decide when we remember that the Californian woodpecker, over a large part of his range, is a mountain bird. Though we think of California as the land of sunshine, it is not universal summer there. The mountain ranges have a winter as severe as that of New England, with a heavy snowfall. When the snow lies several feet deep among the pines and spruces of the uplands, the Carpenter is not distressed for food: his pantry is always above the level of the snow; he need neither scratch a meagre living from the edges of the snow-banks, nor go fasting. His fall's work has provided him not only with the necessities, but with the luxuries of life.

But why does he spend so much time in making holes? He might tuck his nuts into some natural crevice in the oak bark, or drop them into cavities which all birds know so well where to find. And leave them where any pilfering jay would be able to pick them out at his ease? Or put them in the track of every wandering squirrel? Jays and squirrels are never too hon-

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est to refuse to steal, but they find it harder to get the woodpecker's stores out of his pine-tree pantry than to pick up honest acorns of their own. So, like the woodpecker, they lay up their own stores of nuts, and feed on them in winter, or go hungry.

We have had very little aid from anything except the piece of bark we were studying, yet we have learned that the Californian woodpecker is a good carpenter; that he works hard at his trade; that he shows remarkable foresight in collecting his food, much ingenuity in housing it, good judgment in putting it where his enemies cannot get it, and wisdom in the plan he has adopted to give him a good supply of fresh nuts at a season when the autumn's crop is buried under the deep snow.

If I were a Californian boy, I think I should spend my time in trying to find out more about this wise woodpecker, concerning which much remains to be discovered.

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IX

A RED-HEADED COUSIN

BESIDES his half-brothers, the narrow-fronted and ant-eating woodpeckers, the Carpenter has a numerous family of cousins, — the red-headed, the red-bellied, the golden-fronted, the Gila,[1] and the Lewis's woodpeckers. These all belong to one genus, and are much alike in structure, though totally different in color. Most of them are Western or Southwestern birds, but one is found in nearly all parts of the United States lying between the Hudson River and the Rocky Mountains, and is the most abundant woodpecker of the middle West. This well-known cousin is the red-headed woodpecker, the tricolored beauty that sits on fence-posts and telegraph poles, and sallies out, a blaze of white, steel-blue, and scarlet, a gorgeous spectacle, whenever an insect flits by. He is the one that raps so merrily on your tin roofs when he feels musical.

In many ways the red-head, as he is familiarly called, is like his carpenter cousin. Both

[1] So named from being found along the Gila River.

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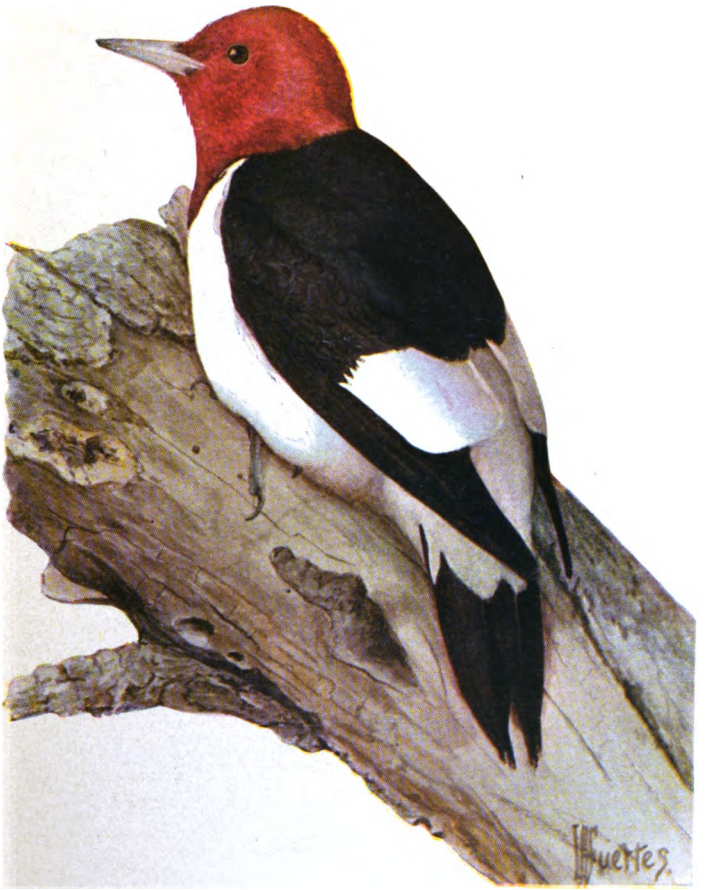

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head hoards, though he is very fond of them. In some parts of the country it is easier to find nuts than to find grasshoppers, and they are much less perishable food. The red-head is very fond of both acorns and beechnuts. Probably he eats chestnuts also. Who knows how many kinds of nuts the red-head eats? You might easily determine not only what he will eat, but what he prefers, if a red-headed woodpecker lives near you. Lay out different kinds of nuts on different days, putting them on a shed roof, or in some place where squirrels and blue jays would not be likely to dare to steal them, and see whether he takes all the kinds you offer. Then lay out mixed nuts and notice which ones he carries off first. If he takes all of one kind before he takes any of the others, we may be sure that he has discovered his favorite nut. Such little experiments furnish just the information which scientific men are glad to get.

It is well known that the red-head is very fond of beechnuts. Every other year we expect a full crop of nuts, and close observation shows that the red-heads come to the North in much larger numbers and stay much later on these years of plenty than on the years of scanty crops. Lately it has been discovered that they not only eat beechnuts all the fall, but store

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them up for winter use. This time the observation was made in Indiana. There, when the nuts were abundant, the red-heads were seen busily carrying them off. Their accumulations were found in all sorts of places: cavities in old tree-trunks contained nuts by the handful; knot-holes, cracks, crevices, seams in the barns were filled full of nuts. Nuts were tucked into the cracks in fence-posts; they were driven into railroad ties; they were pounded in between the shingles on the roofs; if a board was sprung out, the space behind it was filled with nuts, and bark or wood was often brought to cover over the gathered store. No doubt children often found these hiding-places and ate the nuts, thinking they were robbing some squirrel's hoard.

In the South, where the beech-tree is replaced by the oak, the red-heads eat acorns. I should like to know whether they store acorns as they do beechnuts. Are chestnuts ever laid up for winter? How far south is the habit kept up? Is it observed beyond the limits of a regular and considerable snowfall? That is, do the birds lay up their nuts in order to keep them out of the snow, or for some other reason?

It remains to be discovered if other woodpeckers have hoarding-places. We know that

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the sapsucker eats beechnuts, and the downy and the hairy woodpeckers also; that the red-bellied woodpecker and the golden-winged flicker eat acorns; and I have seen the downy woodpecker eating chestnuts, or the grubs in them, hanging head downward at the very tip of the branches like a chickadee. It may be possible that some of these lay up winter stores.

It is known that the Lewis's woodpecker occasionally shows signs of a hoarding instinct. It was recently noted that in the San Bernardino Mountains of California the Lewis's woodpecker, after driving away the smaller Californian woodpeckers, tried to put acorns into the holes the Carpenter had made, but, being unused to the work, did it very clumsily. Soon after this observation was published, a boy friend living near Denver told me that a short time before he had seen a woodpecker that had a large quantity of acorns shelled and broken into quarters, on which he was feeding. This woodpecker was identified beyond a doubt as the Lewis's woodpecker. So we begin to suspect that the habit of storing up food is not an uncommon one among the woodpeckers.

Head of the Lewis's Woodpecker.

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X

A STUDY OF ACQUIRED HABITS

SOMETHING interesting yet remains to be discovered of the hoarding habit of the red-head. How strange that so familiar a bird should have a habit so easily detected, and yet that no one in all these years should speak of it! Who does not know how mice and chipmunks hide their food? Who has not watched the blue jay skulking off to hide an acorn where he will be sure to forget it? Who does not remember the articles his pet Jim Crow stole and lost to him forever? The hoarding habit has long been observed of many dull-colored, rare, or insignificant creatures. That one so noisy, gay-colored, tame, and abundant as our red-headed woodpecker should have the same habit and escape observation is certainly remarkable. But though it is over twenty years since the storing of grasshoppers was recorded and twelve since the practice of laying up beech-nuts was observed, very little seems to have been learned of the habit since these records were made.

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There are two points to be considered: the habit long remained unknown; after it was discovered, it was long in being reaffirmed. It seems that, if it were a general habit, more would be known about it. Now if it is not a universal habit, it must be one of two alternatives, either a custom falling into disuse, or a new one just being acquired. That a habit so remarkable and so advantageous should be discarded after being universal is scarcely possible; that a habit so noticeable, if it were general, should remain unknown is improbable; that a habit which made life in winter both secure and easy should, if introduced by a few enterprising birds, become a universal custom, is not without a parallel. The probabilities point to the custom of hoarding food as a recently *acquired habit.*

Acquired habits are not rare among birds. The chimney swift has learned to nest in chimneys since the Pilgrims landed; for there were no chimneys before that time. There is the evidence of old writers to show that they acquired the habit within fifty years of the time of the first permanent settlements in New England. The eaves swallow learned to transfer its nest from the side of a cliff to the side of a barn in less time. Most birds will change their food as soon as a new dainty is procurable, and they

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will even invent methods of getting it, if it is much to their taste. The way the English sparrows have learned to tear open corn husks so as to eat the corn in the milk is a good example, for our maize does not grow in England, and they have had to learn about its good qualities in the few years since they have become established outside of the cities. Yet it is already a well-established habit. So quickly does a habit spread from one bird to another, until it becomes the rule instead of the exception! Acquired habits always show adaptability, and often much forethought and reason. It is the shrewd bird that learns new tricks.

Now there is not known among birds any evidence of greater forethought and reason than working hard in pleasant weather, when food is plentiful beyond all hope of ever exhausting it, to lay up provision for winter. How does the woodpecker know that winter will come this year? That there was a winter last year and the year before does not make it certain, but only probable, that there will be one this year. We cannot know ourselves that the seasons will change until we learn enough of astronomy to understand the proof. Nor does instinct explain the habit, as some would declare: since not all red-heads have the habit, though all must have

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instinct. It would seem as if memory and reason had devised this plan for outwitting winter, the bird's old enemy.

The red-head is not a grub-eating woodpecker. Though beetles make up a third of his food, their larvæ do not form any part of it. Half his food for the entire year is vegetable, and the animal portion is composed principally of beetles, ants, caterpillars, and grasshoppers, which in winter time are hidden in snug places, or are dead under the snow. There are few berries in winter. The few seedy, weedy plants that stick up above the snow give to the birds the little they have; but the red-head's vegetable fare is limited at that season and his animal food almost lacking. Winter in the North is all very well for the hairy and downy cousins that like to hammer frozen tree-trunks for frozen grubs; but our red-headed friend does not eat grubs by preference. Rather than change his habits he will change his boarding-place. So he is a migratory woodpecker, though the woodpeckers are naturally home-loving birds, and do not migrate from preference. If, however, he can lay up a store of vegetable or animal food, he can winter in any climate. Hoarding is thus an invention as important to the woodpecker world as electric cars and telephones are to men. The proba-

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bilities are that this is a recent improvement in the red-head's ways of living.

Another set of facts increases the probabilities of our supposition. It is a very delicate subject to handle because it affects the reputation of a family in good standing; but there is positive proof that sometimes the red-head has been guilty of crimes which would give a man a full column in the newspapers with staring head-lines. If such deeds were not a thousand times less common among woodpeckers than they are among men the red-head would be declared an outlaw. He has been proved to be a hen-roost robber, a murderer, and a cannibal. In Florida he has sucked hen's eggs. In Iowa he has been seen to kill a duckling. There is a record in Ohio that he pecked holes in the walls of the eaves swallow's nest and stole all the eggs, and that he was finally killed in the act of robbing a setting hen's nest. Within the space of fifteen years, from Montana, Georgia, Colorado, New York, and Ontario, in addition to the records mentioned already from Florida, Ohio, and Iowa, come accounts of his stealing birds' eggs and murdering and eating other birds. The evidence is indisputable.

It is charity to suppose that this is the work of natural criminals, or of degenerate, under-witted,

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or demented woodpeckers. Why should there not be such individuals among birds? One point is certain: so notable a habit could not long escape detection, since it is a barnyard crime. He who robs hen's nests gets caught — if he is a bird. Either these occurrences are very rare, not seen because of their extreme rarity, or they indicate a new custom just coming in. And the same is true of the habit of hoarding food; it is rare, or it is new.

The frequency of such occurrences can be determined only by observation; but the time of their origin might be approximated in another way. If we could fix the date when the bird could not have done what he is now doing for simple lack of opportunity, we might say that the habit has been acquired since a certain date — as we have said of the English sparrow eating maize, of the chimney swift nesting in chimneys, and the cliff swallow building under the eaves. But we have no such help on the case of the red-head, which never has been without opportunities to get birds' eggs and to kill other birds.

But there is a parallel case in another species where the date of an acquired habit can be proved. In Florida the red-bellied woodpecker has earned the names Orange Borer and Orange Sapsucker because he eats oranges. It is true

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that he is not charged with doing damage, because he attacks only the over-ripe and unmarketable fruit; it is known that the habit is not general yet, for even where the birds are abundant only a single bird or a pair will be found eating oranges, and always the same pair, proving that it is a habit not yet learned by all of the species; close observers declare, too, that it is but a few years since the bird took up the habit; and, finally, we know that this must be the case, for, though the wild orange was introduced by the Spaniards, the sweet fruit was not extensively cultivated until recently. Here is a habit which undoubtedly has been acquired within twenty years or so, which will in all probability increase until instead of being the exception it is the rule.

Why may not the red-head's occasional cannibalism, unless this is mere individual degeneracy, and his more common custom of hoarding be habits that he is acquiring? Why, indeed, may not the Californian woodpecker's distinguishing trait be a habit which began like these among a few birds here and there, wiser or more progressive than the rest, and which in time became general and established? Why may not the two observed instances of the Lewis's woodpecker be examples of a similar habit just be-

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ginning? The very differences in their methods point to that explanation. The Lewis's woodpecker that had seen the Carpenter's work tried to imitate him; the one that lived outside his range adopted a way of his own, unnoticed before among woodpeckers, and shelled and quartered his nuts before he stored them.

It is remarkable that these four woodpeckers are cousins; they belong to the same genus, and they have essentially the same structure, tastes, and habits. Why should it be strange if their minds were alike too? if they had a natural bent toward accumulativeness, and a natural desire to try new wrinkles? We are sure that one of them has acquired a new habit within a few years. Why may we not suppose as a basis and a spur to further investigation that the others also are acquiring ways new and strange?

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XI

THE WOODPECKER'S TOOLS: HIS BILL

THERE is an old saying, "You may know a carpenter by his chips;" but, though chips are seldom long absent when a woodpecker is about, can we call the woodpecker a carpenter? Is he not both in his works and ways of working — with the one exception of the Californian woodpecker — more of a miner?

For the carpenter takes pieces of wood, bit by bit, and joins them together till at last he has built a lofty skeleton or framework for his dwelling, which last of all he covers over and closes in; and the tools he uses are saw and hammer. With these alone he could build his house, though it might be neither very large nor very good. When a carpenter's house is finished, it is neither a cave nor a hole, but a pavilion built in the open air after the model of a spreading tree, — which frames a roof with its branches and shingles it with overlapping leaves. There is nothing in the woodpecker's way of building which corresponds to that.

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Quite different are the miner's methods. In the West, where the barren mountain sides stretch up into snowclad summits, on the face of slopes as seamed and gray and verdureless as the wrinkled trunk of an aged oak, I have seen holes where human woodpeckers burrow. The entrance to a mine half-way up a hillside looks strikingly like a woodpecker's hole and scarcely larger. Nor does the likeness vanish as we think how in their long tunnels inside their mountains of gold and iron and silver the delving miners are picking and prying and picking to lengthen their burrows just as the woodpeckers peck and pry and peck inside their wooden mountain, the tree-trunk. Which shall we call the woodpecker — a carpenter or a miner?

What are the miner's tools? Pick and drill, are they not? What are the woodpecker's? The same. Certainly we shall see, if we stop to think, that it is not a chisel that he uses, as we sometimes say. A chisel is a knife driven by blows of a hammer; like a knife its effectiveness depends upon the sharpness and length of its cutting edge. But a woodpecker's bill is not a cutting tool. It is a wedge, but a wedge working on a different principle from a knife-edge. Look at this one and observe that, though strong and stout, it is not sharp and has no true cut-

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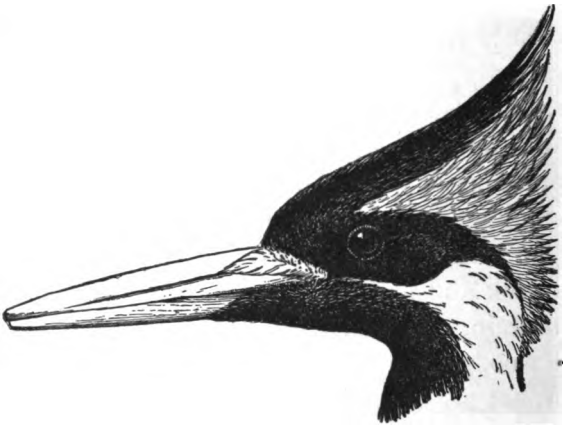
ting edge. It is a tapering, square-ended, flat-sided tool, rather six-sided at the base and holding its bevel and angles to the tip. The woodpecker's bill is a pick, not a chisel. It is used like a pick, being driven home with a heavy



Head of Ivory-billed Woodpecker.

blow and getting its efficiency from its own weight and wedge-shape and from the force with which it is impelled. Watch the downy woodpecker at his work and see what sturdy blows he delivers, pausing after each one to aim and drive home another telling stroke. This is pick-axe work. But sometimes he rattles off a succession of taps so short and quick that they blend together in one continuous drumming, too

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light and quick to be likened to the ponderous swing of the pick-axe. Now he is drilling. The work of a drill is to cut out a small deep hole either by twirling (as in drilling metals) or by tapping (as in drilling stone). The woodpecker drills by the latter method and there is a curious likeness between his bill and the mason's tools.

Any one who has lived in a granite country knows the deep round holes that stone masons make when they split rock. Did you ever wonder why they are as large at the bottom as at the top? If you remember the shape of a mason's drill, you will recollect that it looks a little like a stick of home-made molasses candy bitten off when it was just soft enough to stretch a little. The mason's drill is a round iron rod with a thin, flat end, sharpened on the edge and a little pointed in the centre. In the flattening of the sides and the width across the tip its end resembles that of a typical woodpecker's bill. The woodpeckers that drill for grubs, especially the largest, the logcock and the ivory-billed woodpecker, have the tip remarkably flattened. The likeness to the drill does not go farther because the woodpecker's bill is a combination tool; but it is drill-pointed rather than pick-pointed.

What is the advantage of this compressed

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tip? Can the bird pick as well as he could with a sharp point? The bird and the mason reap the same benefit from this form of tool. A sharp-pointed drill would bind in the hole and could neither be driven ahead nor removed without difficulty, but the sharp-edged tool cuts a hole as wide as the instrument. There is, of course, some difference between working in stone and in wood, but the principle is the same. The mason strikes his drill with his hammer and cuts a crease in the stone; then lifts and turns the drill, cutting a crease in another direction; and so by continually changing the direction of the cuts until they radiate from a centre like the spokes of a wheel, he finally reduces a little circle of stone to a powder fine enough to be blown out of the hole. In drilling for a grub the woodpecker must do much the same thing. He wishes to keep his hole small at the top so as to save work, yet it must be large enough at the bottom to admit the borer when nipped between his mandibles; therefore he needs an instrument that, like a drill or a chisel, will cut a straight-sided hole. Indeed, we might call it a chisel just as well if it were not a double-wedge instead of a single wedge and if it did not move when it is struck instead of being held stationary beneath the blows.

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When he is digging his house the woodpecker use his bill as a pick-axe. When he is digging for grubs he uses it as a drill. Now some species drill very little and some a great deal, according to the number of grubs they feed on; but all dig holes to nest in, — that is, all use their bills as picks but only a few employ them as drills. The flickers, for example, seldom drill for grubs, their food being picked up on the surface or dug from the earth; yet they excavate the deepest, roomiest holes made by any woodpeckers of their size; they use their bills effectively as pick-axes, but seldom, very seldom, as drills. And what do we find? No drill-point — not a truncate, compressed bill fit for drilling, but a sharper, pointed, rounded, *curving* bill. Notice the ordinary pick-axe and see how much nearer the flicker's bill than the logcock's or the ivory-billed woodpecker's it is. Why is a flicker's bill better for being curved also? Why do the drilling woodpeckers have a perfectly straight bill? We should find by studying the birds and their food that there is a direct relation between the shape of the bill and the amount of drilling a woodpecker does; that the grub-eating or drilling woodpeckers have a straight bill, for working in small deep holes, while the flickers have a curved bill for prying out chips. And

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we should note that the flicker's bill is most like the ordinary bill of perching birds, while the drilling bill, as typified by the logcock's and the hairy woodpecker's bills, is a more specialized tool, limited to fewer uses, but more effective within its limits.

There is another detail of the woodpecker's bills which casts light upon their habits. The species that drill most have their nostrils closely covered by little tufts of stiff feathers, scarcely more than bristles, which turn forward over the nostril. The density and the length of these tufts agree very well with the kind of work the woodpecker does; for in the hairy and the downy, which are continually drilling and raising a dust in rotten wood, they are very thick and noticeable, while in the red-head and the sapsucker they show as scarcely more than a few loose bristles, and in the flicker they barely cover the nostril. This seems a plain provision to keep the dust out of the bird's lungs; and we might cite as additional evidence the fact that the only other birds of similar tree-pecking habits, the nuthatches and the chickadees, have their nostrils protected in the same way. But we must always be cautious before drawing inferences of this sort to see what may be said on the other side. When we recollect that the crows and

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ravens and many kinds of finches, among other birds, none of which dig in the bark of trees or raise a dust, have their nostrils as completely covered, we see that we have perhaps discovered a *use* for these nasal tufts but not the *cause* of their being there. We must be careful not to mistake cause and accompaniment in our endeavor to explain differences in structure.

Let us see what we have learned and how to interpret it: —

That the woodpecker's bill is a combination of drill and pick-axe.

That the shape varies with the use to which it is most commonly put.

That the use varies with the food principally eaten; or, what is a step farther back, that the different kinds of food must be sought in different places and by different methods, and therefore require different tools.

Therefore the shape of the woodpecker's bill has a direct relation to the kind of food he eats. Please notice that we do not assert that it *causes* him to eat a certain kind of food nor that a certain diet may not have affected the shape of the bill, causing it to be what we now see. Both may be at least partially true, but to prove either or both would need profound study, and all that we have observed is that the shape of

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the woodpecker's bill is *adapted* to his food and that it varies with the kind of food he eats, or, to be more exact, with his ways of procuring it.

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XII

THE WOODPECKER'S TOOLS: HIS FOOT

We have studied the woodpecker's bill and have found that it is a very serviceable tool. We shall find that his feet are equally well adapted to their work.

Here is the foot of a woodpecker. Observe how it differs from a chicken's foot, or a sparrow's foot. What is it that especially fits it for climbing? Perhaps you will notice that the tarsus is short, and you may be able to explain why it would be a disadvantage for a climbing bird to have long legs, as well as why it is a help for him to have long toes. Toes long and legs short is the rule with the woodpeckers.

Foot of Woodpecker.

I never see a woodpecker's foot without thinking of an iceman's nippers with their short handles and long, sharp-toothed jaws. They are designed for similar uses, — to lift heavy weights by laying hold of smooth, flat surfaces. The iceman sets his nippers into the ice and lifts the

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block; but the bird sets his claws into the tree and lifts his own body.

Suppose the nippers had one short jaw and one long one, would they then take as firm hold as they do with jaws of equal length? In perching birds the hind toe is much the shortest, but they sit balanced upon a limb and have merely to hold themselves in position. The woodpecker climbing a tree-trunk is out of balance; he would fall off unless he had a firm grip; and he could not get this firm hold if his hind toes were not long enough to give his foot a nearly equal spread back and forward. Other birds grasp a limb with the whole under surface of their toes, but the woodpecker when on a smooth, upright tree-trunk nips it only with his toenails. Try with your own hand to hold a stick as large and heavy as you can grasp, and you will see that when you clasp your hand around it as a perching bird takes hold of a perch, it makes little difference that the thumb is shorter than the fingers, but when you try to nip it with your finger tips alone, you must bend your fingers until they are not much longer than your thumb, — that is, a pair of nippers must be equal jawed.

This simple illustration shows why the woodpecker's foot reaches as far backward as for-

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ward. But a sensible objection may be raised, namely, that as there are two hind toes of unequal length, it is by no means certain which is the more necessary.

Scientists tell us that a woodpecker's foot, though it looks so unlike a chicken's, is really very much the same. When we ask how one of the front toes disappeared and how the extra hind toe came to be where it is, they tell us that there has been no addition and no loss, but the extra hind toe is only a front toe turned backward. They call it a *reversed fourth toe.* A bird's toes are numbered in order starting with the hind toe and going around the *inside* of the foot to the outer or fourth toe. The hind toe is the thumb, and the others are numbered in the same order as the fingers of our hands. So we see that the woodpecker's real hind toe is rather small, like that of most birds. It looks very much as if it had been found *too* small and as if another had turned back to help it do its work. Do you say that a bird cannot turn his toes about in this way? Most cannot, to be sure, but all of the owls can do it. An owl will sit either with two toes forward and two backward,

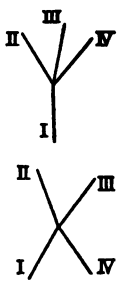

Diagram of right foot.

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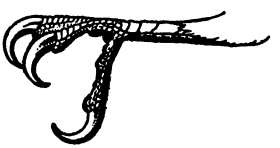
or with three forward and one the other way. The owls have a reversible outer toe, and perhaps the woodpeckers did also before it became permanently reversed.

That this is exactly what had happened is curiously confirmed. There are a few woodpeckers in this country which have but three toes. They are the only North American land birds with less than four toes (though many sea and shore birds have but three). Compare this picture with a four-toed woodpecker's foot. One toe is gone completely, when or how no one can tell. But in some way the *first* toe, the *thumb*, the one we always begin to count from, has disappeared. The one left is the reversed fourth toe, as we know by the number of joints in it. Undoubtedly this woodpecker needed a hind toe, but he must have needed a longer, stronger one than his natural first toe. A toe of the right length was supplied by turning one of the front toes back, and the short hind toe in some way disappeared.



Foot of Three-toed Woodpecker.

This may seem a roundabout way to show that a woodpecker's foot is a pair of nippers. First we studied nippers till we found out that

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they were not good nippers unless they were nearly equal-limbed. Next we studied the woodpecker's foot to learn about that extra hind toe. Then it occurred to us that four toes were not necessary, since some of our best climbers have but three. What was the essential point? Might it not be a foot equally divided without reference to the number of toes? But that is the principle of a pair of nippers. Then came the question, Is there any similarity in their use? Yes, the nippers are used to lift heavy weights, and the woodpecker's foot is used to lift his heavy body in just the same way, by taking hold of a flat, smooth surface. We conclude that a wide-spread, equally divided, nipping foot would be the best device possible for the woodpecker's way of living, and we find by examination that every woodpecker shows this type of foot.

There is additional evidence that this is the right explanation. Our only other North American birds that climb on the bark of trees professionally, as we may say, are the brown creepers and the nuthatches. In both these the tarsus is short, as we found it in the woodpeckers, and the hind toe and its claw are fully equal to the middle toe and claw, making an equally divided foot. On the other hand, the foot with two toes

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forward and two toes backward is confined neither to woodpeckers nor to climbing birds. The parrots, which climb after a fashion, have it; but so do the cuckoos, which do not climb, some of which, like our road-runner, or ground cuckoo of the West, are strictly terrestrial. The "yoking" of the toes may occur by the reversion of the fourth toe, as ordinarily, or of the second toe, as in the trogons; the arrangement appears to be definitely related to the distribution of the tendons that control the toes. But though accounting for the structure may give a clue to its descent, it does not justify its efficiency. The yoke-toed foot is not exclusively a climbing foot. All our families of climbers have at least one representative with but one toe behind, and this clearly proves that the yoke-toed structure is by no means necessary even though it may be an honorable inheritance among climbers. The natural conclusion is that the important point in climbing is not the number nor the arrangement of the toes, but the length of at least one hind toe so as to give an equally divided foot.

There is an interesting point to notice about the woodpeckers. This reversed fourth toe is curiously variable in length. In the flickers, with its claw, it is a little shorter than the middle (third) toe with its claw; in the red-heads and

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their friends it a little exceeds the middle toe and claw; in the downy and the hairy it is much the longest toe, and in the ivory-billed woodpecker it is abnormally developed. We at once judge that it is some indication of the bird's manner of life, and we look for it to be largest in the species that live continually upon the trunks of trees, obtaining most of their food by drilling. We expect to see the finest development of drilling bill accompany this enormously developed toe, and we find them both in the ivory-billed woodpecker. In imagination we clearly see the use of it. The great bird, keen in his quest of grubs, sidling hastily round the tree, in an unsteady balance and unsupported by his tail, throws one long hind toe downward to steady himself, hooks the other into the bark above him, and hangs between the two as firmly supported as in his ordinary position. No doubt he does do this, but does it prove the supposition that the heaviest and most arboreal woodpeckers have the greatest development of the fourth toe? Not at all. There is our rare acquaintance the logcock, or pileated woodpecker, a bird nearly as large as the ivory-billed, one of the most persistent of our tree-climbers and more than any other woodpecker I ever observed given to scratching rapidly round and round a tree-

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trunk, clinging at ease in almost any position except head-downward, and drilling incessantly and at all seasons for grubs; he is a typical woodpecker of the largest size, but his hind toe and claw are, if anything, a trifle shorter than his middle toe with its claw. He throws it out and uses it as we have described, but it has not that disproportion to the other toes which we expected to find as the result of a strictly arboreal life.

What have we proved? We have not shown that the long toe is *not* more useful than the shorter one, — that is a matter of observation; but we have failed entirely to show that it is so, and this can be done only in one of two ways: either by proving that the logcock's habits are not what all previous observers have believed them to be, — which would be assuming a great burden of proof; or by demonstrating that his ancestry explains why his feet do not illustrate our theory, — and this, though it is undoubtedly the true solution, could be settled only by a very learned man.

But we have encountered one truth which must always be held in mind in science — that a theory is not proved while a single fact remains rebellious and unsubdued. We might have examined every other woodpecker in the

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continent but just one; we might have seen that every other one agreed with our theory, as it does; we might have supposed that the explanation was good past doubting; but that one exception — if it was a logcock — would still overturn the whole theory; and the very facts that we relied upon to strengthen us — its resemblance in size, habits, shape, and color to the ivory-billed woodpecker — have been the strongest possible means of totally demolishing our fine theory. We have learned, if nothing more, that all the facts must be examined and accounted for before an explanation is accepted as indisputable.

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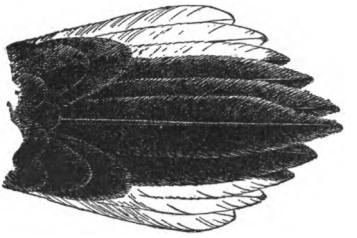
XIII

THE WOODPECKER'S TOOLS: HIS TAIL

If we study the woodpecker's anatomy and observe his broad, strong, highly-arched hip-bones and the heavy, triangular "ploughshare" bone in which the tail feathers are planted, as well as the stiffness and strength of the tail itself, we must conclude that it is not by accident that he uses his tail as a prop. The whole structure shows that the bird was intended "to lean on his tail." What we wish to discover is how good a tail it is to lean on.

Our first impression is that the woodpecker's tail might be improved. Why are not the tips of the feathers stiffer? Why is it so rounded? Most of the work seems to fall on the middle feathers, and in some species, as the downy and the hairy wood-



Tail of Hairy Woodpecker.

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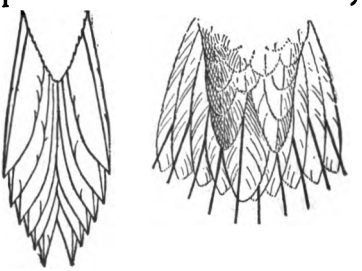
peckers, these end in decurved tips so soft and unresisting that they seem quite unfit to give any support. Would it not be better if the woodpecker's tail had been cut square across and made of feathers equally rigid and ending in short stiff spines? For we see that the woodpecker's tail is not only weak in its inner feathers, but weaker still in its outer ones, and it is stiff, in most species, only in the upper three fourths of its length.

When we propose a change in nature it is wise to inquire whether our improvement has not been tried before and to learn how it worked. How many kinds of birds have we that use their tails for a support? What are their habits and what sort of tails have they?

Besides the woodpeckers we have but two kinds of land birds that prop themselves with their tails, — the swifts and the creepers. The creeper has a tail very much like the woodpecker's as it is; while the chimney swift's is precisely like the woodpecker's as we thought it ought to be. But we observe that



Tails of Brown Creeper (under surface) and Chimney Swift (upper surface.)

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while the creeper's habits are almost precisely like the woodpecker's, — so much so that when we first make his acquaintance, some of us will be sure we have discovered a new kind of woodpecker, — the chimney swift has but one habit in common with the woodpecker, that of clinging to an upright surface and propping himself by his tail. If the bird with the tail most like the woodpecker's has the woodpecker's habits, is it not a fair inference that this form of tail is better fitted to this way of living than the other would be?

Next, what variations in shapes do we observe among the woodpeckers themselves? The logcock and the ivory-billed woodpecker have the longest tails — because they are the largest birds. When we compare the length of the tails with the length of the birds we are surprised at the results. On measuring sixteen species, representing seven genera, I find that the tail is from three tenths to thirty-five hundredths of the entire length; that it is, in proportion, as long in the flicker as in the ivory-bill, as long in the downy as in the logcock, and longer (in the specimens measured) in the almost wholly terrestial flicker than in the wholly arboreal logcock. Without much more study all that we can safely infer is that the woodpecker's tail is not far from

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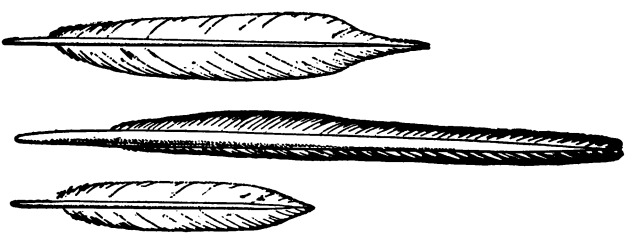
one third the length of his whole body measured from the tip of the bill to the tip of the tail. Probably this is the proportion most convenient for his work.

All woodpeckers' tails agree in one particular: they are rounded at the end. At first sight we would say that some are but slightly rounded and others very deeply graduated; but as nearly as I can determine this is at least partly an optical illusion, explained by the great difference in the shape of the feathers making up the tail, which in some, as the flicker, are very broad and abruptly pointed, and in others taper gradually to



Middle tail feathers of Flicker, Ivory-billed Woodpecker, and Hairy Woodpecker.

the end and are very narrow for their length. The larger birds naturally appear to have longer tails, and the effect of narrow feathers is to make the tails appear longer and more sharply graduated than they really are. This diagram

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shows the shape of the curve in six species, and indicates that, while the curvature is less than we might expect, it bears some relation to the bird's way of living; for we see that the strictly arboreal woodpeckers have more pointed tails than the terrestrial species, and that the amount of gradation bears a direct relation to the amount of time spent upon the tree-trunks.

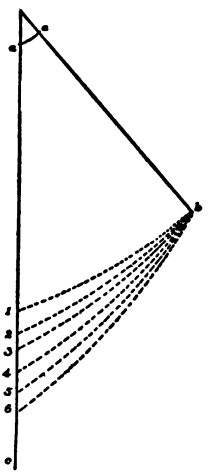

Diagram of curvature of tails of Woodpeckers. Drawn to scale.

a, *a*, point of insertion in rump.
a, *b*, outer tail feather.
a, *c*, middle tail feather.
If the outer tail feather were of the same length in all cases, the curve at the end of the tail would be represented by the dotted lines.
1. Flicker.
2. Red-headed Woodpecker.
3. Downy Woodpecker.
4. Logcock.
5. Central American Ivory-billed Woodpecker.
6. North American Ivory-billed Woodpecker.

There is a third difference, the shape of the individual feather, to which we shall refer again; but now we wish to examine the uses and meaning of the curved end.

I will show you how to prove this point so that you may be satisfied about it even if you should never see a woodpecker. We will make a little experiment, so simple that even a child can understand it.

First, how many shapes can any bird's tail have? It may be one of three general patterns,

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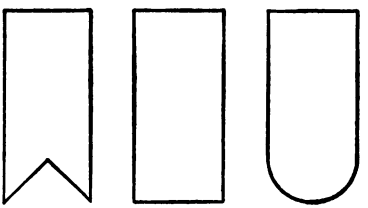
and it can be nothing else unless we combine those patterns. It may be square across the end, it may have the middle feathers longest, or it may have the outer feathers longest. To one of these patterns every form of birds' tails may be referred; you can invent no other shape.

Let us assume that you know nothing whatever of a woodpecker's tail except that it has ten feathers, is used as a prop, and is held at an angle of thirty or forty degrees with the tree-trunk. Now, take three strips of paper of the same width and length, and of any size not inconveniently small. Fold them all down the centre. Cut one square across; cut one with a rounded end and the third with a forked end, making them of any shape you please so long as the three papers are of the same length. To give our models a fair test they must be of the same width and length. Next, pin a sheet of paper of any size you please into the form of a cylinder and stand it on end to represent a tree-trunk. Then fit the patterns to the tree-trunk and see which is the form that would give the most support.



Patterns of tails.

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But first, in how many ways is it possible for a bird to use his tail as a prop? He may of course hold it open or closed; and the open tail may be held in a single plane, "spread flat," as we say; or curved up at the edges, like a crow blackbird's; or curved down at the edges. And the closed tail may be held in a single plane; or, by dropping each pair of feathers a little, in several planes. Thus we see there are five positions in which each shape may be held against the cylinder of paper. Try each one against it, holding it first in the open positions and then after folding the paper like a bird's tail with the outer feathers underneath, in the closed positions. The size of the model tree-trunk and the shape you cut your curves will make the results vary a little, but you will be surprised to observe, if your models are not too small, how many times you will get the same answers. Note the number and position of the pairs that touch:

Spread.	*Square end.*	*Forked end.*	*Round end.*
one plane,	varies	varies	middle pair
curved up,	middle pair	middle pair	middle pair
curved down,	all	all	all
Closed.			
one plane,	outer pair	outer pair	middle pair
different planes,	outer pair	outer pair	all

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Which shape brings the most feathers into use in all positions? Which positions bring most feathers into use? We see at once that the rounded end has a decided advantage, that the middle pair of feathers is used in all possible positions, that the pair next outside is the next important, and that the spread tail curving downward at the edges and the closed tail in different planes are the two shapes which give the best support. There is therefore a reason for the rounded end which we said was the rule among the woodpeckers.

Our little experiment is what we call a *deduction*. It shows us what we ought to expect under certain imaginary conditions. But it does not show us what actually exists, so there often comes a time when our deductions are faulty because Nature has done some unexpected thing, as when we found the single exception of the log-cock's foot upsetting a fine theory of ours. A deduction must always be compared with facts, and is worth little or nothing if a single fact of the series we are studying is not explained by it. This time all the facts do agree; for I had, before we made our experiment, examined the tails of every species of woodpecker ever found in North America, and there was no exception to the rounded end. I had already drawn my con-

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clusion that this form was better adapted to life on a tree-trunk than the square or the forked tail would be, reasoning by a different process called *induction*. An induction examines many, and, if possible, all the facts before drawing any conclusion; a deduction examines the facts after the conclusion is reached. There is no hard-and-fast line between the two kinds of reasoning, but we may say that a *deduction is reasoning out a guess and an induction is guessing out a reason*. Deductions are easier and quicker; inductions are surer, and in preparing them we often make other discoveries.

The rounded tail is no doubt the best; but we have yet to decide whether the sharper curve is more advantageous than the lesser curve, as we thought probable from our observations. And there is still another deduction from our experiment which we did not make. If in the rounded tail the middle pairs of feathers do most of the work, and if use increases the size and efficiency of a part, which is almost an axiom in science, we should expect to find the middle tail feathers not only strongest in all woodpeckers but also strongest in increasing ratio in the species that use them most. To determine this we must study the use of the tail and the structure and shape of the individual tail feathers.

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We should remark, perhaps, that the woodpecker's tail is always composed of twelve feathers — ten pointed rectrices and two tiny abortive feathers so short and so hidden that no attention is paid to them. The ten principal feathers are arranged in corresponding pairs numbered from the outside to the centre as first, second, third, fourth, and fifth pairs.

In the flickers all ten feathers have wide vanes and are similar in everything but the shape; all are more or less pointed. The flicker's tail looks and feels very much like that of any other bird except that the shafts are stiffer and the vanes contract to an acuminate tip. But as we take up the other species we notice a change, not only in the shape of the feathers but much more in their texture and in the difference between the various pairs. While in the flicker four pairs out of five are pointed and all are rigid, in the downy and the hairy three pairs out of five seem to be too soft to give any support, the sharp points have disappeared, and the tail has lost much of its stiffness. The two middle pairs of feathers are the only ones capable of doing much work and they are wavering and infirm at the tips where we should expect them to be strongest. In the logcock it is about the same, — two pairs are apparently unfit for work, one

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pair is infirm, and the two middle pairs are compelled to give all the support, except the little contributed by the third pair. In the ivory-billed woodpecker the two outer pairs are of no assistance and the three central ones do the work, and here again we find the base of the rectrices rigid and inflexible and the last fourth of their length weak and yielding. But what a difference in the individual feather! It is well able to do all the work; for, except for that weak tip which we cannot now explain, it is one of the toughest and strongest feathers to be found. The shaft is broad and flat, as elastic as a watch-spring; it looks like a band of burnished steel as it runs down between the vanes. And the vanes themselves are of a very curious pattern. They curl under at the edges so that we do not see their whole width, and the barbs crowd so thickly upon each other that they over-lie until they present an edge three or four broad. Indeed, the under side of one of these tail feathers reminds one of nothing so much as of the under side of a star-fish's arm with its two long lines of ambulacral suckers on each side of a central groove, so thickly do the spiny vanes of these strong rectrices over ride and crowd together. These spines lay hold of the bark of the tree, rank after rank, hundreds of bristling points

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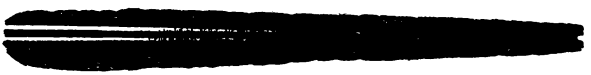
that cannot be dislodged except by a forward motion of the bird or by lifting the tail. Compared with this, the spiny points on the flicker's tail were a poor invention. This device, which takes hold like a wool card, or a wire hair-brush,



Under side of middle tail feather of Ivory-billed Woodpecker.

cannot slip from place. We begin to see, too, the use of that weak and flexible tip; it is to press down upon the tree-trunk a flat surface sufficiently large to hold hundreds of these little spiny points against the bark. The ivory-bill braces against this with the stiff upper part of the shaft and has a support that will not slip. The upper part of the shaft acts like a spring also, and adds tremendous force to the blow of the bill. Watch a hairy woodpecker when hard at work and see how his legs and tail form a triangular base by bracing against each other, and how his blow is delivered, not with the head alone, but with the whole body, swinging from the hips, the apex of the triangle on which he rests. He swings like a man wielding a sledge hammer, and to the strength of his neck adds the weight of his body, the spring of his

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tail, and the momentum of a blow delivered from a greater height. When the little hairy woodpecker does so much with his weak body, we can imagine what great birds like the logcock and the ivory-billed woodpecker, with their tremendous beaks, their huge claws, their springy tails, and their great physical strength can do. They are magnificent birds, the terror of all the grubs that hide in tree-trunks.

One point we have left unexplained: What is the advantage, if there is any, in the sharper curve to the tails of the arboreal woodpeckers? It is a simple question. The curve is caused by the unequal length of the tail feathers; each tail feather is a prop, and by their inequality they become props of different lengths. Now ask any carpenter which will best support a tottering wall — props all of the same length set at the same angle, or props of different lengths set at different angles? His answer will help you to solve the problem. But if a little is good, why are not all the pairs used as props? Partly, perhaps, because the woodpecker is always crowded for houseroom, and while he must have tail enough, he cannot afford to have any which he does not use. Did you ever think what an inconvenience any tail at all must be in a woodpecker's hole?

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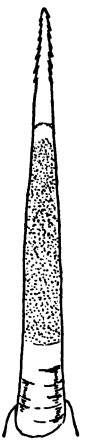
XIV

THE WOODPECKER'S TOOLS: HIS TONGUE

We have seen how the woodpecker spears his grubs: now we will study his spear.

There are many interesting points about a woodpecker's tongue, and they are not hard to understand. If a woodpecker would kindly let us take hold of his tongue and pull it out to its full extent we should be afraid we were "spoiling his machinery," for the tongue can be drawn out almost incredibly — between two and three inches in a hairy woodpecker and more in a flicker. A strange-looking object it is, much resembling an angle-worm in form, color, and feeling; for it is round, soft, and sticky, except at the flat, horny, bayonet-pointed tip, and as it lies in the mouth it is wrinkled like the wrist of a loose glove; but it grows smaller and smoother the more we pull it out. Evidently we are only drawing it into its skin. But where does so much tongue



Tongue of Hairy Woodpecker. (After Lucas.)

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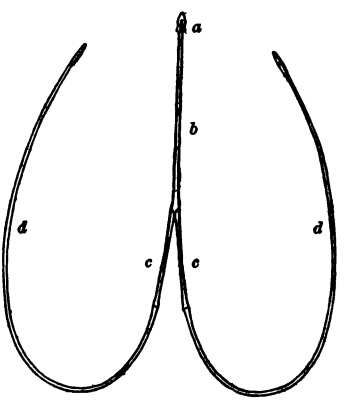
come from? Does it stretch like a piece of elastic cord? Or is a part hidden somewhere? And if so, where is it kept?

These questions are answered by studying the bones of the tongue, for without bones it could not be guided as swiftly and surely as it is. Indeed, all tongues have bones in them, as you will discover by cutting carefully the slices near the root of an ox-tongue; but no other creature has such long and elaborate tongue-bones as some of the woodpeckers. They are the slenderest and most delicate little bony rods, joined end to end, but not really hinged nor needing to be, because they are so elastic. Here are the bones of a flicker's tongue. The little knob at the end, marked *a*, bore the horny point of the tongue and directed it; the straight shaft marked *b* was inside the round part of the tongue as it lay within the bird's mouth; but



Tongue-bones of Flicker. (After Lucas.)

a. Cerato-hyals, fused and short.
b. Basi-hyal, long, slender.
c. Cerato-branchials.
d. Epibranchials.
Basi-branchial is wanting.

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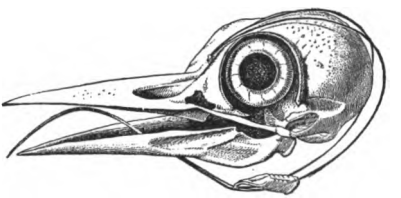
what was done with these two long branches, fully three quarters of the entire length of the bones? They are too sharply curved to pass down the bird's throat, and, not being jointed, they cannot be doubled back in his mouth. They were tucked away very neatly and curiously. As the hyoid or tongue-bone lies in the mouth its branches diverge just in front of the gullet, and, traveling along the inner sides of the fork of the lower jaw, pass up over the top of the skull, looking in their sheath of muscles like two tiny whipcords. But still the bones are too long by perhaps half an inch for the place they occupy, and the ends must be neatly disposed of. Usually both pass to the right nasal opening and along the hollow of the upper mandible. Very rarely they may curl down around the eyeball in a spiral spring. So when the flicker thrusts out his tongue he feels the pull in the end of his nose, for the tip of the tongue being run out, the long slender bones are drawn out of their hiding-places, down over the skull until they lie flat



Skull of Woodpecker, showing bones of tongue.
a. Upper end of windpipe and gullet.

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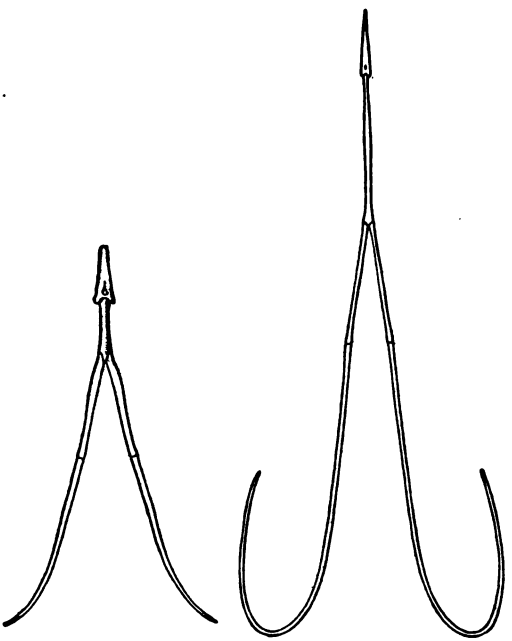
along the roof of his mouth. As soon as he wishes to shut his bill, back fly the little bones guided by their hollow sheaths of elastic muscle



Hyoids of Sapsucker and Golden-fronted Woodpecker.

into their hiding-place in the top of the bill. The muscular covering is a part of the same soft envelope that we saw lying in wrinkles at the root of the tongue. It covers the whole length

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of the little bones just as the woven outside covers an elastic cord.

Not all woodpeckers have tongues precisely like this. The sapsucker's is the shortest of any, and reaches barely beyond the hinge of the jaws. In the Lewis's woodpecker and others of his genus the branches of the hyoid extend partway up the back of the skull; but in the kinds that live principally upon borers they are very long and resemble the flicker's in arrangement. The only other North American birds that have a tongue built upon this plan are the hummingbirds, in which also it is extensile. The flicker, in proportion to his size, has the longest tongue of any bird known.

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XV

HOW EACH WOODPECKER IS FITTED FOR HIS OWN KIND OF LIFE

We have studied the woodpeckers at some length: first, what all of them do; next, what some that are peculiar in their ways do; lastly, how each is fitted for a particular kind of life. At first we were inclined to think they were all alike; but now we begin to see that there are very real differences between them, — in tails, feet, bills, and tongues, and at the same time in their food and habits.

The flicker's tail is less sharply curved than that of any other woodpecker, — a sign that he is probably not exclusively a tree-dweller; his bill is curved and rounded, a pickaxe rather than a drill, — an indication that he does not dig for grubs; his feet do not tell us much; but his long extensile tongue shows that, whatever he feeds upon, he seeks it in holes. We find a tongue like this in no other bird, but among mammals the aard-vark, the ant-bear, and the pangolins are all similarly equipped, and all live

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on ants which they extract from their mounds and burrows in hundreds by means of these round, sticky, and extensile tongues. This is precisely the way the flicker gets his living. He lives principally upon the ground or near it, pecks very little except when digging his nest, and feeds largely upon ants, thrusting his head into the ant-hills and drawing out the ants glued to his tongue rather than speared by it. As he has been known to eat three thousand ants for a meal, we see how much easier this is than spearing them one by one.

The red-head is another type. The bill is still nearly of the pickaxe model, the feet not especially different from the flicker's, the tail rather better adapted to life on a tree-trunk, and the tongue entirely unlike the flicker's, — not very extensile and heavily clothed near the tip with long, thick, recurved bristles. We infer that though he may climb well, he is not a drilling woodpecker to any great extent, and that his tongue is adapted neither to extracting borers nor to eating ants from their burrows. His habits bear out the inference. He is arboreal, but his food is either vegetable or picked up from the surface, rasped up rather than speared.

The sapsucker presents still another variation. The points to the tail feathers are more acu-

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minate and the tail itself more resembles that of the tree-dwelling woodpeckers in shape; the feet are fitted for clinging to the trunk; the bill, now perfectly straight and no longer smoothly rounded but buttressed by strong angles that spring from the base and run down toward the tip, is the bill of a woodpecker that lives by drilling; but the tongue is wholly unadapted to catching grubs. What kind of food can an arboreal woodpecker with a drilling bill find upon a tree-trunk when his tongue can be extended only a fifth of an inch, and is furnished with a brush of bristles at the end? We have answered that question before: he eats the inner bark of trees and laps up the sap, for which this brushy tip is excellently fitted. It has been observed that the tongue much resembles the tongues of insect-eating birds, which cannot be extended beyond the end of the bill. It is true that the sapsucker catches great numbers of insects, taking them on the wing like a flycatcher. But he also eats nearly as many ants as the flicker, though their tongues are totally unlike. We have made the mistake perhaps of thinking that ants live only underground and can be obtained only by tongues like those of the flicker and the ant-bear, which hunt them there. But ants are abundant on the surface of the

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ground, and they excavate long tunnels in rotten wood. The black bear is a famous ant-hunter, yet his tongue is like a dog's and he gets his ants by lapping them up after he has torn open the rotten logs in which they live. This is the way that the sapsucker obtains his ants, and the brush of stiff hairs is a help to him in such work. We see, then, that it is not so much the food as the manner of feeding that explains the form of the tongue.

The downy and the hairy are a step farther along in their development. The fourth toe is longer than the others, a condition that we do not find in any of the woodpeckers not strictly arboreal; the tail is of the improved pattern, holding by a brush of bristles rather than by one stiff point at the end of each feather; the bill is heavier, broader at the base, more heavily ridged, and in every way a stronger tool; and the tongue is highly extensible and of the spear pattern, sharp-pointed and barbed with recurved hooks. Everything about these birds indicates that they are fitted to live on tree-trunks and to dig for borers. This, indeed, is what they do.

But the great logcock and the ivory-billed woodpecker, though of the same type as the other larvæ-eating woodpeckers, are more highly developed along the same line. We notice the

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great strength of the feet; the claws, as large and as sharp as a cat's; the enormous weight and strength of the bill, compared with that of the other woodpeckers, which enables them to cut into the hardest wood and even into frozen green timber; and the great development of the tail, which now becomes a strong spring to support and aid the bird in his work.

As we try to group these particulars under general heads, we see that we have observed three things: —

That the structure of a bird is adapted to its kind of life.

That the structure varies by small degrees with the kind of life.

That the kind of life is conditioned largely upon the kind of food and upon the method of procuring it, more particularly the latter.

These are not so much different truths as three aspects of one truth. When we study the first we see why birds are grouped together into orders and families: we study their resemblances. When we observe the second we see why they are divided into species, for we note their differences. But when we consider the third and reflect that birds have the power to choose new kinds of food or new places and means of getting it, we see how it is that there

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can come to be new kinds of birds, new subspecies and species, springing up from time to time. Wonderful and improbable as it seems, there is more reason to believe than there is to doubt that new kinds of animals and plants are constantly in process of making; that the laws of change are constantly at work, adapting creatures to their surroundings or crushing them out of existence because they will not learn new ways. And it is probable that these differences which we mark in the woodpeckers have been the result of efforts to adapt themselves to a peculiar kind of life where food was abundant; and also that by acquired habits and by acquired tastes for different kinds of foods they will be subject to still further variations in the future.

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XVI

THE ARGUMENT FROM DESIGN

But if the birds are making themselves into new species, where is the place for God in the universe? Did not God make all kinds of creatures in the beginning? How can they go on being made without God?

These are questions every one ought to ask, but — did God leave his world after He had made it and go a long way off? Did He wind it up like a watch to go till it should run down? Is the world a machine, or is it alive?

Long ago the wise and good man Socrates argued that if you did not know there was a God at all, you could at least infer it because everything was so wonderfully made. "There is our body," said he: "every part of it so perfect and so reasonable. Consider how the eyes not only please us with agreeable sensations but are protected in every way. The eyebrows stand like a thicket to keep the perspiration from them, the lids are a curtain to shut out too great light, the lashes screen them from dust, — everything

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is planned for some wise and reasonable end. And where the evidence of design is so convincing must we not believe that there was a Designer?" Words like these he spoke, and we know because everything is so perfectly contrived that there must have been a contriver, who knew all from the beginning. We are compelled to believe that there is a God.

Shall we believe it less because we find in the creatures about us intelligence and the power to care for their own lives? Has God gone on a visit because these living creatures are looking out for themselves? Were they made less perfectly in the beginning because when new conditions surround them they are able to change to meet the strange requirements? This is not less evidence of a Designer, but more. It was long said that the existence of a watch was proof of a watchmaker who had planned and put together all the parts so that they worked harmoniously. But if the watch had the power to grow small to fit a small pocket, or large to fit a large one, to become luminous by night, and to correct its own time by the sun instead of being regulated by outside interference, what should we have said — that it was proof there was no watchmaker? or that it showed a far more skillful one, since he could make a living, self-regulating, adaptive watch?

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And so of the world and the creatures in it. Every evidence we get that they can care for themselves, that they can adapt themselves to new conditions, that they are intelligent and reasonable, capable of improvement in habits or in structure, is so much surer proof that a wise God made them what they are. Evolution — for that is the name by which we call these changes — does not take God out of the universe but makes the need of Him stronger. The argument from design is immensely strengthened when we consider that we have not only an obedient machine acting according to a few fundamental rules, but one that is intelligent also and capable of self-modification.

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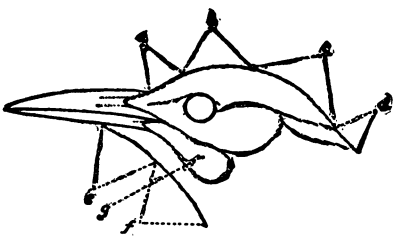
APPENDIX

Explanation of Terms.



Head of a Flicker.

a. Forehead ; *b.* crown ; *c.* occiput ; *d.* nape ; *e.* chin ; *f.* throat ; *g.* jaw-patch, or mustache.

Occipital means "on the occiput."

Nuchal means "on the nape."

Primaries are the nine or ten wing-quills borne upon the last joint of the wing.

Secondaries are the wing-quills attached to the fore-arm bones.

Tertiaries are the wing-quills springing from the upper arm bones.

Wing coverts are the shorter lines of feathers overlapping these long quills.

Tail coverts are the lengthened feathers that overlap the root of the tail both above and below, called respectively upper and under tail coverts.

Ear coverts are the feathers that overlie the ear, often specially modified or colored.

Rump, the space between the middle of the back and the root of the tail.

♂ is the sign used to indicate the male sex.

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♀ is the sign used to indicate the female sex.

A *subspecies* is a geographical race, modified in size, color, or proportions chiefly by the influence of climate. These variations are especially marked in non-migratory birds of wide distribution, subject, therefore, to climatic extremes. The Downy and the Hairy Woodpeckers, for example, are split up into numerous races. It should be remembered that when a species has been separated into races, or subspecies, all the subspecies are of equal rank, even though they are differently designated. The one originally discovered and first described bears the old Latin name which consisted of two words, while the new ones are designated by triple Latin names — the old binomial and a new name in addition. The binomial indicates the form first described. The forms designated by trinomials may be equally well known, abundant, and widely distributed. For example, among the woodpeckers, the northern form of the Hairy Woodpecker was first discovered and bears the name *Dryobates villosus;* but the first Downy Woodpecker described was a southern bird, and the northern form was not separated until a few years ago, so that the southern bird is the type, and the northern one bears the trinomial, *Dryobates pubescens medianus.*

North America, by the decision of the American Ornithologists' Union, is held to include the continent north of the present boundary between Mexico and the United States, with Greenland, the peninsula of Lower California, and the islands adjacent naturally belonging to the same.

The following key and descriptions will enable the student to identify any woodpecker known to occur within these limits:

A. Key to the Woodpeckers of North America.

Family characteristics: color always striking, usually in spots, bars, or patches of contrasting colors, especially black and white, Sexes usually unlike; male always with some portion of red or yellow about head, throat, or neck. Tails stiff, rounded, composed of ten fully developed pointed feathers (and two undeveloped feathers). Wings large, rounded, with long, conspicuous secondaries, and short coverts. Bill straight, stout, of medium

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length. Toes four, arranged in pairs, except in the three-toed genus. Iris brown, except when noted. Marked by a habit of clinging to upright surfaces and digging a deep hole in a tree-trunk for nesting. Eggs always pearly white.

I. Very large — 18 inches *or more;* conspicuously crested. A.
II. Medium or small — 14 inches *or less;* never crested. B.

A. a^1 Bill gleaming *ivory white;* fourth toe decidedly longest.
Ivory-billed Woodpecker. 1.

a^2 Bill *blackish;* fourth toe not decidedly longest.
Pileated Woodpecker or Logcock. 14.

B. a^1 Toes three; ♂ with *yellow* crown.
Three-toed Woodpeckers. 9 & 10.

a^2 Toes four; crown never yellow (b).

b^1 *Not spotted nor streaked either above or below* (c).

c^1 Body clear black; *head white.*
White-headed Woodpecker. 8.

c^2 Blue-black above; *rump white; head* and *neck red.*
Red-headed Woodpecker. 15.

c^3 Greenish black above, with *pinkish red belly.*
Lewis's Woodpecker. 17.

c^4 Greenish black with *sulphur yellow forehead* and *throat.*
Californian Woodpecker. 16.

c^5 Glossy blue-black with *scarlet throat* and *yellow belly.*
Male of Williamson's Sapsucker. 13.

b^2 *Spotted with black or brown on breast and sides,* but not streaked nor barred with white (d).

d^1 *Brown* spots on breast and sides; upper parts plain brown.
Arizona Woodpecker. 7.

d^2 *Black* spots on breast and sides; wings and tail brilliantly colored beneath (e).

e^1 Wings and tail *golden* beneath; mustaches *black* in male, wanting in female.
Flicker. 21.

e^2 Wings and tail *golden* beneath; mustaches *red* in both sexes.
Gilded Flicker. 23.

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e^2 Wings and tail *golden red* beneath; mustaches red.
Red-shafted Flicker. 22.

e^4 Wings and tail *golden red* beneath; mustaches red; crown brown.
Guadalupe Flicker. 24.

b^5 *Streaked, spotted, or barred with white on back and wings* (f).

f^1 *Back streaked, plain,* or *varied, never* barred with white; wings *spotted* with white (g).

g^1 *Clear* white and black; *white streak down the back* (h).

h^1 Medium size, 9–11 inches.
Hairy Woodpecker. 2.

h^2 Small size, 6–7 inches.
Downy Woodpecker. 3.

g^2 *Grayish* white and black; *sides closely barred* (i).

i^1 Back plain black, white *stripe* down side of throat.
Female of Arctic Three-toed Woodpecker. 9.

i^2 Back with interrupted white stripe, white *line* down side of throat.
Female of American Three-toed Woodpecker. 10.
(NOTE. — The males are similar with the addition of the yellow crown. The three toes cannot ordinarily be seen in life.)

g^3 *Yellowish* (often dingy or smutty), white and black; under parts yellowish; back varied with white, no line nor streak; *rump white; white wing-bars* (j).

j^1 Breast with black patch; head of adult with red patches.
Yellow-bellied Sapsucker. 11.

j^2 Breast and head red.
Red-breasted Sapsucker. 12.

f^2 *Back barred with white;* wings spotted or barred with white (k).

k^1 Belly *white; ear coverts white.*
Red-cockaded Woodpecker. 4.

k^2 Belly *white; forehead black.*
Nuttall's Woodpecker. 6.

k^3 Belly *smoky brown;* forehead and breast same.
Texan Woodpecker. 5.

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k^4 Belly *sulphur or lemon yellow.*
Female of Williamson's Woodpecker. 13.
k^5 Belly *pinkish red.*
Red-bellied Woodpecker. 18.
k^6 Belly *yellow*, hind neck and forehead orange.
Golden-fronted Woodpecker. 19.
k^7 Belly *yellow*, hind neck brown.
Gila Woodpecker. 20.

B. Descriptions of the Woodpeckers of North America.

The following are descriptions of all the species of Woodpeckers found in North America, arranged in their proper genera and in the order given in the check list of the American Ornithologists' Union, 1895; with the range of species and subspecies as defined by the same authority or by Bendire's "Life Histories of North American Birds."

1. Campephilus principalis, *Ivory-billed Woodpecker.*
Glossy black except *white secondaries* (very conspicuous) and white stripe from beneath ear down neck and shoulders; white nasal tufts; *bill white.* Both sexes crested; ♂ with scarlet occipital crest, ♀ with crest black. Iris yellow. 20 inches.
Cypress swamps of Gulf States, locally distributed.
The largest, shyest, and rarest of our woodpeckers.

2. Dryobates villosus, *Hairy Woodpecker.*
Black and white. Upper parts glossy black with a broad *white stripe* down the back; wings thickly spotted with white; under parts white; three outer pairs of tail feathers white; two white and two black stripes on sides of head; nasal tufts brownish white. ♂ with scarlet occipital patch. 9–10 inches.
Eastern United States except South Atlantic and Gulf States, with the following subspecies, all the races being resident the year round, and breeding in most places where they are found: —

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a. *D. v. leucomelas, Northern Hairy Woodpecker.* 10–11 inches. Larger, whiter.
British America.

b. *D. v. audubonii, Southern Hairy Woodpecker.* 8–8.5 inches. Smaller, more dingy white.
South Atlantic and Gulf States.

c. *D. v. harrisii, Harris's Woodpecker.* 9–10 inches. Upper parts with less white, few wing spots, under parts soiled white or smoky brown; larger than next.
Northwest coast, northern California to Alaska.

d. *D. v. hyloscopus, Cabanis's Woodpecker.* 8.5–9.5 inches. White stripe down back very wide; purer white below than *harrisii;* fewer wing spots than *leucomelas* and *villosus.*
Western United States, except northwest coast, east to the Rocky Mountains.

e. *D. v. monticola, Rocky Mountain Woodpecker.* 10–11 inches. Larger; more white spots near bend of wing and secondaries than *hyloscopus,* fewer than *villosus;* pure white below.
Rocky Mountains west to Uintah Mountains, Utah.

3. DRYOBATES PUBESCENS, *Southern Downy Woodpecker.* Black and white; broad *white stripe* down back; wings thickly spotted with white; under parts white. ♂ with scarlet occipital patch. A miniature Hairy Woodpecker, differing only in having *four* outer pairs of tail feathers more or less white and the *outermost barred.* 6.5 inches. Like the Hairy Woodpecker, the Downy and its subspecies are resident and breed wherever they occur.
South Atlantic and Gulf States.

a. *D. p. gairdnerii, Gairdner's Woodpecker.* 6.75 inches. Bears same relation to Downy that Harris's does to Hairy Woodpecker; under parts smoky white; wings spots few.
Pacific coast north to about lat. 55°.

b. *D. p. oreœcus, Batchelder's Woodpecker.* 7.5 inches. Under parts pure white; under tail coverts unspotted; fewer wing spots than *medianus* and *pubesceus.*
Rocky Mountain region of United States.

c. *D. p. medianus, Downy Woodpecker.* 7 inches.

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The larger, whiter form seen in New England and the Northern States.

d. *D. p. nelsoni, Nelson's Downy Woodpecker.*
Whiter, larger, with fewer black bars on outer tail feathers.
Alaska and region north of 55°.

4. DRYOBATES BOREALIS, *Red-cockaded Woodpecker.*
Upper parts black *barred* with white, under parts dingy white; sides streaked and spotted with black; wings spotted with white; outer tail feathers barred; nasal tufts and *large ear patch white;* stripe of black down side of neck. ♂ with a tiny tuft of scarlet feathers on each side of head. 7.5–8.5 inches.
Pine woods of southeastern United States, from Tennessee southwest to eastern Texas and the Indian Territory; casual north to Pennsylvania.

5. DRYOBATES SCALARIS BAIRDI, *Texan Woodpecker, Ladder-backed Woodpecker.*
Upper parts barred with black and white on back, wings, and outer tail feathers; sides of head striped; forehead, nasal feathers, and under parts *smoky gray,* brownest on belly; *crown speckled with white or red;* ♂ with nape crimson. 7—7.5 inches.
Southern border of United States, Texas to California, north to southwestern Utah and southern Nevada; generally resident.

a. *D. s. lucasanus, St. Lucas Woodpecker.* Larger.
Lower California, north to 34° in Colorado desert.
These are both subspecies of a Mexican species not occurring within our limits.

6. DRYOBATES NUTTALLII, *Nuttall's Woodpecker.*
Upper parts barred with black and white; under parts and *outer tail feathers white* or dingy white; nasal tufts white; *forehead and crown black sprinkled with white.* ♂ with red on occiput and nape. 7–7.5 inches.

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Southern Oregon and California west of Sierra Nevada and Cascade Ranges; most common in the oak belt of the foothills.

Easily distinguished from Downy Woodpecker by being barred on the back, instead of striped.

7. DRYOBATES ARIZONÆ, *Arizona Woodpecker.*

Upper parts plain brown, not spotted nor streaked; primaries dotted with fine white dots; outer tail feathers barred; under parts white, *thickly spotted* (except throat), *with large, round, brown spots.* ♂ with red occipital band. 7.5–8.5 inches.

Southern Arizona and southwestern New Mexico; among oaks of the foothills from 4000 to 7000 feet elevation.

8. XENOPICUS ALBOLARVATUS, *White-headed Woodpecker.*

Glossy black all over, except showy white patch on primaries, and *head and throat pure white* (forehead and crown sometimes grayish). ♂ with broad occipital band of scarlet. 9 inches. "Iris pinkish red" (Bendire).

Mountains of Pacific coast, east to western Nevada and western Idaho, usually in the pine and fir forests above 4000 feet altitude.

9. PICOIDES ARCTICUS, *Arctic Three-toed Woodpecker.*

Glossy black above, unmarked except by fine white spots on primaries; under parts grayish white, sides thickly barred black and white; three outer pairs of tail feathers white, sides of throat with broad *white stripe.* ♂ with *large crown patch of deep yellow.* 9.5 inches.

British America, south into the northern tier of States and into the Sierra Nevada Mountains to Lake Tahoe.

Most commonly seen in the track of forest fires, where it is usually abundant for about two years; rare outside of the extensive soft wood tracts, and usually found singly or in pairs except when on burnt land. I have found this species far more common than the next, and the best mark in life to be the white *stripe* on the neck, in distinction from the white *line* of *P. americanus.*

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10. PICOIDES AMERICANUS, *American Three-toed Woodpecker.*
Very similar to preceding species, but with narrow bars of white forming an *interrupted stripe down the back;* head thickly sprinkled with white in both sexes and a white line on nape or just below; a *white line,* too narrow to be called a stripe, down side of throat. ♂ with *crown bright yellow.* 9 inches. Same range in the East as last; replaced in West by following subspecies: —

a. *P. a. alascensis, Alaskan Three-toed Woodpecker.*
Smaller; more white; nape very white; more white on top of head.
Alaska, south to 48°. (Mt. Baker, Washington).

b. *P. a. dorsalis, Alpine Three-toed Woodpecker.*
More white on back and head than *P. americanus,* less than *alascensis;* but continuous, not barred. "Iris dark cherry-red" (Mearns).
Rocky Mountain region, south to New Mexico and Arizona.

11. SPHYRAPICUS VARIUS, *Yellow-bellied Sapsucker.*
Under parts whitish or pale sulphur yellow; upper parts black, mottled with pure or yellowish white; *rump white;* wings spotted, and with conspicuous white coverts; tail black with *outer webs of outer feathers* and *inner webs of middle feathers light colored;* sides streaked; breast with a *broad black patch* extending in a "chin-strap" to the corners of the mouth; sides of the head striped. Occiput black, nape white. ♂ with forehead, crown, chin, and throat crimson; ♀ usually with crown crimson, forehead black, and throat white, back more brownish; ♀ sometimes, and young always, with crown blackish. 7.5–8.5 inches.
Colors vary much with age, sex, and season; the wing bar and yellowish tinge are good marks for all plumages; the rump and breast patch for adult birds.
Eastern North America, breeding from Massachusetts northward, migrating in winter to the Southern States.

a. *S. v. nuchalis, Red-naped Sapsucker.*
Similar, but an additional red stripe on nape, and the black chin-strap replaced by crimson. 8–8.5 inches.

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Rocky Mountains to Coast Range, replacing the above in the mountains; usually breeding at from 5000 to 10,000 feet elevation.

12. SPHYRAPICUS RUBER, *Red-breasted Sapsucker.*

Body and under parts similar to *S. varius*, but back much less variegated with white. No black on breast, no white stripe through eyes. Nasal tufts brownish instead of white. *Head, neck,* and *breast uniform crimson. Sexes alike.* Young with crimson replaced by gray or "claret brown" (Bendire). 8.5–9 inches.

Pacific coast, Sierra Nevada, and on both sides of Cascade Mountains; a summer resident only north of northern California.

At first sight the Red-breasted Sapsucker might be mistaken for the Red-headed Woodpecker, but the two birds do not inhabit the same country.

13. SPHYRAPICUS THYROIDEUS, *Williamson's Sapsucker.*

Sexes totally dissimilar except in having a white rump and yellow under parts. *Male, glossy black all over except* conspicuous *white rump* and *white wing coverts,* two white stripes on sides of head, white nasal tufts, white spots on primaries; sides and tail coverts mottled; a stripe of scarlet down middle of throat and *brilliant yellow under parts. Female, light brown;* head clear brown; body, wings, and tail closely *barred* with black and white; no white wing coverts; rarely a red throat like male; usually but not always a large black patch on breast, and always a *yellow belly* and *white rump.* Young males lack the red on the throat and usually the yellow on the belly; the black is dull, and the throat a dingy white. Young females lack the yellow on the belly and the black on breast, and are dull-colored and indistinctly marked. 9–9.5 inches.

Rocky Mountain region, west to Sierra Nevada, Cascades and northern Coast Ranges, breeding at from 5000 to 9000 feet elevation. The handsomest of our woodpeckers.

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14. CEOPHLŒUS PILEATUS, *Pileated Woodpecker, Logcock.*
Body blackish slate; wings with a large white patch conspicuous only when flying; throat white; a white stripe across cheek and down neck; jaw-stripe scarlet in male, blackish in female; both sexes with scarlet crest, but in the male the whole top of head (which is slaty black in female) equally brilliant. This red cap gives the bird the name of *pileated*. Iris yellow. 17 inches.

Wooded regions of Southern States, Florida to North Carolina, very rarely near settlements, but far more common than the following subspecies of the North and West.

a. *C. p. abieticola, Northern Pileated Woodpecker.*
Larger; more extensive white markings; the black grayer or browner.

From Virginia northward to 63° in the East, and in the West among the Rocky Mountains, north of Colorado, to the northwest coast; a shy woodland bird to be looked for only in the primitive evergreen forests, though sometimes occurring in any heavy timber and, in New England, upon the higher well-wooded mountains. The largest of the northern woodpeckers; resident.

15. MELANERPES ERYTHROCEPHALUS, *Red-headed Woodpecker.*
Wings, tail, and upper parts glossy blue-black; rump, exposed secondaries, and under parts from breast downward pure white; *head, neck,* and *breast crimson. Sexes alike.* Young with red and black wholly or partly replaced by grayish brown; can be recognized by white markings. 9.5 inches.

United States, west to Rocky Mountains; rare east of Hudson River, but ordinarily breeding wherever found; in winter usually migratory from its northern limits, the migration depending principally upon the food supply and depth of snow.

16. MELANERPES FORMICIVORUS, *Ant-eating Woodpecker.*
Upper parts, wings, and tail glossy greenish black; *rump*

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and lower parts *white;* white patch on primaries, conspicuous in flight; upper throat and line about the bill dull black; *forehead* with *wide white band;* lower *throat sulphur yellow;* breast and sides thickly streaked with black and white. ♂ with crown and occiput crimson; ♀ with crown black, occiput crimson. Iris white. 7–9 inches.

Mexico; western Texas.

a. *M. f. angustifrons, Narrow-fronted Woodpecker.*
Similar, but with a *narrow band of white* across the *forehead;* breast and sides not so thickly streaked.

Lower California, never occurring within the borders of the United States.

b. *M. f. bairdi, Californian Woodpecker, El Carpintero.*
Similar to *M. formicivorus,* but the breast black, little streaked with white except along the sides; yellow of throat paler, or replaced by white. Iris white. Larger, 7.5–9.5 inches.

Pacific coast, north into Oregon to 44°, east to southern New Mexico and Texas in the south and to the eastern slopes of the Sierra Nevada and Cascade Mountains in the north, but more abundant on the western than on the eastern slopes of these mountains.

17. MELANERPES TORQUATUS, *Lewis's Woodpecker.*
Upper parts, wings, and tail glossy greenish black; under parts *pinkish red;* chest and *collar round hind neck hoary gray;* crown and sides of head black; forehead, cheeks, and chin crimson. *Sexes alike.* Young with pink replaced by grayish. 10.5–11.5 inches.

Pacific coast, east to Black Hills and Rocky Mountains between Arizona and 49th parallel; casual still farther east; migratory in its northern ranges; a silent, heavy flying bird, different in habits and appearance from the other woodpeckers; often seen flycatching.

18. MELANERPES CAROLINUS, *Red-bellied Woodpecker, Zebra Bird.*
Back and wings black, *barred with white;* under and upper

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tail coverts, middle and outer tail feathers, white varied with black; head and under parts ashy; *belly tinged with reddish.* ♂ with whole top of head and nape bright red; ♀ with forehead and nape red, crown gray. 9–10 inches.

Eastern and Southern States between the Hudson River and the Rocky Mountains, north to southern New York, Ohio, southern Michigan, etc.; migratory in its northern ranges.

19. MELANERPES AURIFRONS, *Golden-fronted Woodpecker.*

Back and wings barred with black and white; rump white; entire under parts brownish white, unspotted (except under tail coverts); primaries unspotted, except at tip; tail black with slightly barred outer feathers; *belly yellowish; forehead and hind neck orange in both sexes.* ♂ with *crown red* set in a larger patch of clear gray; ♀ with crown clear gray. 9.5 inches.

Central and southern Texas, north to about 33°; breeds wherever found.

20. MELANERPES UROPYGIALIS, *Gila Woodpecker.*

Back and wings barred with black and white; *head and lower parts smoky brown;* rump black and white; tail barred on inner and outer feathers; primaries unspotted; belly yellow (not conspicuous). ♂ with red crown surrounded by brownish; "iris red" (Hayden). 9 inches.

Southwestern New Mexico and Arizona to southeastern California, usually above 2000 feet altitude; its distribution depending principally upon the giant cactus.

21. COLAPTES AURATUS, *Flicker, Yellow-hammer, High-hole, Clape.*

Back and wings (except primaries) brownish gray, barred with black; under parts pale vinaceous spotted with black spots from breast downward; *rump white; tail and wings golden yellow beneath,* dark above, showing the yellow shafts; tail feathers with black tips below; top of head ashy gray, sides of head and throat vinaceous; a broad *black crescent*

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across breast, a bright scarlet one on nape. ♂ *with black jaw patches;* ♀ without them. 12 inches.

South Atlantic and Gulf region, north to North Carolina.

a. *C. a. luteus, Northern Flicker.*

Larger; paler; black bars above narrower; less black and white below.

North from North Carolina and west to the Rocky Mountains; casual farther west; migratory from its northern ranges.

22. COLAPTES CAFER, *Red-shafted Flicker.*

Color pattern similar to above with the following differences: *wings and tail red beneath* instead of yellow; throat ashy gray; usually no red on occiput (though some specimens show a narrow crescent). ♂ *with red jaw patches.* 12.5–14 inches.

Rocky Mountain region west to Pacific coast from Mexico to British Columbia, except northwest coast region of Oregon, Washington, and British Columbia, and occasionally east to Kansas and Nebraska; resident except in the more northern portions of its range.

a. *C. c. saturatior, Northwestern Flicker.*

Darker; smaller; narrower breast crescent.

Northwest coast, replacing the above, from which it cannot be separated in life.

23. COLAPTES CHRYSOIDES, *Gilded Flicker; Cactus Flicker.*

Color pattern same as *C. auratus,* but throat gray; top of head brown; *occiput without band;* tail band broader and yellow paler than in *C. auratus.* ♂ with *jaw patches bright red;* "iris blood red" (Hayden).

Central and southern Arizona and Lower California.

a. *C. c. brunescens, Brown Flicker.*

A curious subspecies of the last, smaller, with larger, more numerous spots and a smoky brown cast of plumage; black tail band very wide; jaw patches red; wings and tail yellow beneath.

Lower (not southern) California; casual only in southern California; in Arizona to 35°.

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24. COLAPTES RUFIPILEUS, *Guadalupe Island Flicker.*

Coloration like *C. cafer*, crown decidedly brown; crescent on nape wanting; jaw patches red; wings and tail *red* beneath.

Guadalupe Island off the coast of Lower California.

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